

SYNTHETIC VISION EFIS

CHELTON
FLIGHT SYSTEMS

FLIGHTLOGIC

Pilot's Guide & Reference

(Blank Page)

FlightLogic EFIS

Synthetic Vision Flight Display

Pilot's Operating Guide and Reference

Document 150-045240, Rev F.

EFIS Software Version 5.0A or Later

© 2004.

Chelton Flight Systems Inc.

All rights reserved.

No part of this document may
be reproduced in any form or
by any means without the
prior written consent of
Chelton Flight Systems, Inc.

FlightLogic and Virtual VFR
are trademarks of
Chelton Flight Systems, Inc.

All other brand names and
trademarks are the property
of their respective holders.

Manual Part Number:

150-045240

050104.ug50.fm

1109 Main St., Suite 560, Boise, ID 83702 • Phone: (208) 389-9959 • Fax: (208) 389-9961

www.cheltonflightsystems.com

Contents

SECTION 1 Introduction.....	1-1
Welcome	1-1
Before You Fly	1-2
About this Guide	1-4
Revision History	1-7
 SECTION 2 System Overview	 2-1
General Description	2-1
System Configuration	2-3
Operational Warnings	2-5
Acronyms and Abbreviations	2-7
Coloring Conventions	2-10
Caution/Warning/Advisory System	2-12
Displays	2-16
Controls	2-16
Database and Software Updates	2-19
Attitude/Heading Reference System	2-25
Standard AHRS (Crossbow)	2-25
Optional AHRS	2-26
Air Data Computer (ADC)	2-27
GPS/WAAS Receiver	2-28
Analog Interface Unit (AIU)	2-30
Input Signals	2-31
Autopilot Output Signals	2-31
Component Failure Modes	2-32
 SECTION 3 Display Symbology	 3-1
PFD Symbology	3-2
Basic PFD	3-3
PFD on Approach	3-4

PFD on Approach (Cont.)	3-5
Unusual Attitude Recovery Mode	3-6
Helicopter PFD	3-7
Navigation Display Symbology	3-68
Basic Moving Map	3-69
Moving Map with Instrument Approach	3-70
Moving Map with STAR	3-71
Conventional HSI/RMI Format	3-72
Traffic Display	3-73
Lightning Display	3-74
North-Up Arc Mode	3-75
North-Up Centered Mode	3-75
Heading-Up Centered Mode	3-76
Failure Modes	3-126
GPS Failure	3-129
ADC Failure	3-133
AHRS Failure	3-134
ADC and GPS Failure	3-135
ADC and AHRS Failure	3-136
GPS and AHRS Failure	3-137
GPS, ADC, and AHRS Failure	3-138

SECTION 4 Button/Menu Functions 4-1

Overview	4-1
Button Functions	4-3
PFD Top Level Menus	4-5
Flight Plan Function	4-6
ACTV (Active) Function	4-7
ACTV (Active) Options	4-10
INFO Function	4-13
OBS (Omnibearing Selector) Function	4-15
HDG (Heading) Function	4-16
NRST (Nearest) Function	4-17
Direct-To Function	4-18
Timer Function	4-20
Bug Set Function	4-21
PFD Declutter Function	4-23
Navigation Display Top Level Menus	4-24
Faults Function	4-26

Strike Format Function	4-28
Traffic Format Function	4-29
Fuel Set Function	4-30
MFD Display Function	4-31
Moving Map Format Function	4-32

SECTION 5 Step-by-Step Procedures 5-1

Setting Altimeter	5-1
Setting Fuel Quantity	5-2
Flight Plans	5-3
Create and Store a Flight Plan	5-4
Activate a Stored Flight Plan	5-7
Edit a Stored Flight Plan	5-8
Reverse a Stored Flight Plan	5-12
Delete a Stored Flight Plan	5-14
Transfer Flight Plans Between Aircraft	5-16
Waypoints	5-18
Nearest Waypoint	5-18
Direct to Any Waypoint	5-20
Recenter on Route	5-22
Activate a Waypoint within an Active Route	5-23
Add a Waypoint or Airway to an Active Route	5-25
Delete a Waypoint From an Active Route	5-27
Create a User Waypoint	5-29
Edit a User Waypoint	5-35
Waypoint Information (NavData)	5-38
Transfer User Waypoints Between Aircraft	5-40
Using Airways (Victor/Jet Routes)	5-42
Approaches, DPs, and STARs	5-44
Select a VFR Approach	5-44
Select an IFR Approach	5-47
Select a DP or STAR	5-51
Missed Approach Arming Procedure	5-55
Parallel Track Function	5-57
Omnibearing Selector Function	5-59
Automatic OBS -- GPS	5-59
Manual OBS -- GPS	5-60
VOR OBS -- HSI	5-62
HSI Source Selection	5-63

Timer Functions	5-65
Count Up	5-65
Count Down	5-66
Flight Timer	5-67
Turn the Timer Off	5-67
BUG Functions	
(Heading, Altitudes, Airspeed,	
V-Speeds)	5-68
Set the Heading Bug	5-68
Turn Heading Bug Off	5-68
Specify a Target Altitude	5-69
Specify a Minimum Altitude	5-71
Specify a Target Airspeed	5-72
Turn Bugs Off	5-72
Set V-Speeds	5-73
Vertical Navigation (VNAV)	5-74
Change VNAV Angles	5-74
Enroute Descents	5-74
Controlling The Displays	5-77
Change MFD Display Pages	5-77
Show/Hide Terrain (Moving Map)	5-77
Show/Hide LAT/LON (Moving Map)	5-78
Show/Hide RMI/ADF (Moving Map)	5-78
Show/Hide RMI/ADF (HSI)	5-79
Show/Hide Strikes (Moving Map)	5-79
Scale the Moving Map	5-79
Change Moving Map Format	5-80
Change Moving Map Function	5-81
Declutter the Moving Map	5-82
Auto Declutter Navigation Symbolology	5-83
Declutter The PFD	5-83
Zoom the PFD	5-84
Controlling the Stormscope Display	5-86
Centered or Arc Format	5-86
Route On or Route Off	5-86
Strike or Cell Mode	5-86
Clear Strikes	5-86
Strike Test	5-87
Controlling the Traffic Display	5-88
Route On or Route Off	5-88

Traffic Test	5-88
Tuning Radios using the EFIS	5-89
Analog Autopilot Interface	5-90
Departure, Enroute, and Arrival Procedures	5-90
Non-precision approaches	5-90
Precision approaches	5-91
Vectors to final	5-91
Missed approaches	5-91
Digital Autopilot Interface	5-94
 SECTION 6 Quick Start Tutorial	 6-1
 SECTION 7 IFR Procedures	 7-1
Overview of Approaches	7-1
Basic Instrument Approach Operation	7-2
Approaches with Course Reversals	7-15
Approaches with DME Arcs	7-20
Vectors to Final (VTF)	7-24
ILS Approaches	7-26
Missed Approaches	7-29
Departure Procedures (DPs)	7-33
Standard Terminal Arrival Routes (STARs)	7-37
 SECTION 8 Appendix	 8-1
Emergency/Abnormal Procedures	8-1
Emergency Procedures	8-1
Abnormal Procedures	8-2
Normal Procedures	8-4
Power Up and Self Test	8-4
Operation	8-4
Operating Tips	8-8
Descent Planning	8-8
Terrain Clearance	8-8
Departure Airport Information	8-8
Pattern Entry	8-9
Unique Names for Flight Plans	8-9
Your Instrument Scan	8-10
TAWS Functions	8-11
Jeppesen NavData Chart Compatibility	8-41

Aeronautical Information Compatibility	8-41
Navdata Name Conventions:	
Waypoint Identifiers	8-44
Data Logging and Retrieval	8-54
Overview	8-54
Data Format	8-55
Service Difficulty Report	8-56
Warranty	8-57

Section 1

Introduction

Welcome

Congratulations on your acquisition of a Chelton Flight Systems FlightLogic EFIS (Electronic Flight Instrument System).

In the last two decades, aviation has become more and more complex; as a result, cockpit resources have followed the commercial carriers' trend toward **automation-centered** systems. These sophisticated systems minimize pilot involvement and automate control of the aircraft and its systems to the greatest extent possible, thereby relegating the pilot to the role of manager and emergency backup. Examples are flight directors and fly-by-wire systems where the pilot is removed from the information loop.

Your Chelton EFIS, on the other hand, was conceived and designed as a **“pilot-centered”** system. While still highly automated, this type of system, common in military tactical applications, presents the pilot with information necessary to make decisions about the flight and take the appropriate actions. A good example is the skyway (highway-in-the-sky) it allows for highly automated approaches but its predictive nature gives the pilot unprecedented awareness of upcoming maneuvers. Contrary to the popular idea of overloading the pilot with information and options, Chelton Flight Systems EFIS products clearly and concisely present **ONLY** necessary information. This reduces pilot workload, decreases task complexity, and minimizes confusion. The result is safer flying.

Chelton Flight Systems' goal is **IFR-VFR equivalence** and the basic concept of the FlightLogic EFIS is proven HUD

symbology overlaying a real-time 3-D virtual reality view of the outside world. The resulting “**synthetic vision**” provides the pilot in IMC with the same simple visual clues for navigation and aircraft control as those used in VFR conditions. This “**virtual VFR**” eliminates the need to scan multiple instruments for aircraft control or mentally interpret complicated enroute and approach procedures. As you gain experience with your Chelton EFIS, you will fly with more precision, awareness, and confidence than you ever thought possible.

Before You Fly

While the EFIS is extraordinarily easy to operate, it does rely heavily on advanced display concepts, so you will likely be exposed to some new terminology and ideas in the following pages.

FOR SAFETY OF FLIGHT, IT IS ESSENTIAL THAT YOU STUDY THIS ENTIRE MANUAL PRIOR TO FLYING WITH THE EFIS.

Using the Demonstration Application built into the EFIS, you can fly anywhere and perform any procedure (except takeoff and landing) that you can do in your aircraft. To use this feature:

1. With the power **OFF**, insert the data card a display (gold side up).

2. Power the system **ON** and select the **RUN DEMONSTRATOR/TRAINING APPLICATION** option using the control knob (turn to scroll, push enter).

```
Chelton Flight Systems Ground and Maintenance Functions:

Run Demonstrator/Training Program
Update Databases, Limits and Application
Download Log Files
Fuel Tank Calibration (CPU#0 or CPU#1 Only)
View Fuel Tank Calibration Map (CPU#0 or CPU#1 Only)
View bitlog.dat
L3 WX-500 Maintenance Utility (CPU#0 or CPU#1 Only)
Ryan TCAD Maintenance Utility (CPU#0 or CPU#1 Only)
Terrain Data Verification
Display Internal Temperature
Download Routes and User Waypoints
Upload Routes and User Waypoints
View System Limits (CPU#0 or CPU#1 Only)
```

3. Practice procedures described in this guide.

When you are finished, power the system **OFF** and remove the data card.

Your Chelton dealer can supply you with a power adapter to allow running this application on a display screen at home while your system is being installed. Ask your dealer for details.

We recommend flying the system for 10 hours and completing at least 5 full instrument approach procedures (including the missed approach) in VFR conditions before use in actual instrument conditions. Professional instruction and recurrent training are highly recommended. For a list of Chelton authorized flight instructors, please visit our website at www.cheltonflightsystems.com.

If you ever have any questions about the use of your FlightLogic EFIS, please do not hesitate to contact your Chelton dealer for assistance.

About this Guide

This document describes the operation of the Chelton Flight Systems EFIS with the software version specified in the footer at the bottom of the page and is divided into eight sections as follows: Introduction, System Overview, Display Symbolology, Menu Functions, Step-by-Step Procedures, Quick Start Tutorial, IFR Operations, and Appendix.

System Overview

The **System Overview** provides a basic system description and block diagram, operational warnings, acronyms and abbreviations, coloring conventions, and a detailed description of the EFIS hardware.

Use this section . . .

to gain a basic understanding of the system.

Display Symbolology

The **Display Symbolology** section provides identification of each screen element of the flight display. For each software screen, every element of the symbology is identified on a sample screen. Immediately following the sample screens, all elements for that screen are listed in alphabetical order. This section also covers failure modes.

Use this section . . .

to identify and understand the elements you see on the screen.

Menu Functions

The **Menu Functions** section shows a flow diagram and selection options for each button and menu menu.

Use this section . . .

when you want to determine the function of a specific button or menu.

Step-by-Step Procedures

The **Step-by-Step Procedures** section will guide you through each system function.

Use this section . . .

when you want to perform a specific task like creating a flight plan or selecting an approach.

Quick Start Tutorial

The **Quick Start Tutorial** will give you the basics you need to go for a VFR familiarization flight with the system. In a few simple steps, you will learn to enter a waypoint and control the view on the display.

Use this section . . .

in conjunction with the Approved Flight Manual Supplement before you fly for the first time and for a quick refresher when needed.

IFR Operations

The **IFR Operations** section provides detailed information about selecting and flying instrument approaches, arrivals, and departures.

Use this section . . .

to familiarize yourself with instrument procedure conventions.

Appendix

The **Appendix** section contains support material and other useful information about system operation including a complete Flight Manual Supplement and detailed discussions of TAWS functions.

Use this section . . .

to review normal and emergency procedures, operational tips, specifications, or other reference material.

Joe Pilot



“Hi, I’m Joe Pilot.

I have about a thousand hours flying this system and I’ll share some tips with you as you read through the manual. Due to the advanced nature of this thing, you may come across stuff you’ve never even thought about before. I’ll explain, in plain language, the important concepts that you need to know to use the system safely. Being a pilot, you probably hate to read instructions but, please, at least flip through the manual and listen to what I have to say.”

Revision History

Date	Document Version	Software Version	Changes
12/20/02	Rev. A	4.0C	Original
	Rev. B	4.0F	4. Added notice about lack of skyway terrain clearance 5. Miscellaneous edits
8/1/03	Rev. C	4.0H	1. Replaced “warble tone” with “chime” 2. Added hover vector symbology 3. Added note regarding repeating alarms 4. Added tadpole ILS symbology 5. Added marker beacon symbology 6. Added RMI/ADF symbology 7. Added flight director symbology 8. Updated menu structure diagrams 9. Added detail regarding Zoom function 10. Added detail regarding Lat/Lon function 11. Deleted “pulled to ground” references in TAWS description 12. Changed knob rotation direction for map scale 13. Added note to altimeter setting instructions regarding flight path marker behavior above 50’ AGL while on ground 14. Added note regarding paper charts vs. NavData 15. Added reference to Terrain NOTAM on website 16. Added details regarding GPS failure modes and dead-reckoning limitations 17. Added Part 27/29 airspeed tape 18. Updated component failure mode matrix 19. Added discussion of wind calculation errors 20. Added description of discontinuity 21. Rewrote IFR Procedures section 22. Added additional NOS charts to IFR Procedures section 23. Updated TAWS system description in Appendix 24. Updated menu diagrams and added descriptions 25. Added holding pattern course reversals 26. Created new cover artwork 27. Added software version to revision history 28. Added software version number to cover 29. Miscellaneous edits
8/7/03	Rev. D.	4.0J	1. Updated software version to 4.0J

11/21/03	Rev. E.	4.1A	<ol style="list-style-type: none"> 1. Added description of AIU. 2. Added step-by-step autopilot procedures. 3. Added note regarding use of RMI on arcing approaches. 4. Added MPH reference to indicated airspeed description. 5. Added reference to third-party sensors. 6. Revised waterline symbology throughout. 7. Revised VSI and airspeed trend indicators throughout. 8. Added note regarding fuel totalizer disabling on some installations. 9. Added Gamma 1 reference to GPS WAAS description. 10. Added full-time bank angle scale option. 11. Updated unusual attitude display to include chevrons. 12. Updated ILS and flight director symbology. 13. Added aural annunciation of obstructions. 14. Updated traffic and terrain pop-up behavior. 15. Added OAT probe failure mode. 16. Removed arc mode in traffic display. 17. Updated behavior of flight timer. 18. Removed flightplan requirement for DPs. 19. Updated maximum number of flight plans. 20. Updated fuel setting procedure with new graphic. 21. Added default value for minimum altitude bug. 22. Added increment reference to AGL indication, based on source. 23. Added reference to Level-Off inhibit below 1,500 AGL. 24. Updated software version to 4.1A. 25. Miscellaneous edits.
----------	---------	------	--

5/28/04	Rev F	5.0A	<ol style="list-style-type: none">1. Enabled DPs from enroute airports2. F/S AOA indication3. Added Ft./NM climb angle setting for DPs4. Radio altitude display limited to +20 to +2,500 ft.5. Expanded VSI range6. Added RADAR INVALID caution7. Added menu lockout8. Added electronic slip indicator9. Added remote nav and com tuning functions10. Independent MFD settings between screens11. Added Mach display to PFD12. Added SEARCHING message to long search functions13. Added DECEND NOW option for HITS14. Enhanced display of obstructions on moving map15. Expanded fuel flow display16. Added ILS, ARTCC, and FSS to NEAREST function17. Added Victor airways and Jet routes to flight planning and ACTIVE functions18. Added transparency to TAWS caution and warning colors on moving map to make terrain contours visible19. Added TAWS mode graphics to MFD Terrain description20. Renamed intersections (INT) to fixes (FIX)21. Added terminal fixes to navigation database22. Added V1, V2, Vr, and Vref settings23. Increased moving map range to 400NM24. Added color-coded airspace depiction25. Added altitude capture predictor for climbs and descents26. Added OBS SYNC function27. Added quick increment function (+5/-5 minutes) to countdown timer28. Enabled DIRECT-TO waypoints in procedures29. Changed TABS nomenclature to MAINS in fuel setting function30. Eliminated heading deviation alert31. Enabled multiple flight plans between same airport pairs32. Raised EFIS cooling caution limit to 95°C33. Changed "Level Off" annunciation to 30% of VSI threshold. Inhibited within approach procedures34. Removed countdown chime from alert prioritization scheme35. Increased maximum number of user waypoints to 50036. Eliminate need for keyboard to perform database updates37. Added Class A and Helicopter TAWS38. Added transferring of routes and user waypoints.39. Enlarged waterline symbol40. Updated warranty41. Added detailed ILS procedure42. Updated GPS failure mode43. Added instructions for ground training mode44. Added Airplane Flight Manual Supplement to Appendix45. Updated software version to 5.0A46. Added unique flight plan names to Tips section in Appendix47. Added warning regarding VFR approaches48. Added date to revision history49. Revised CWA alerts section50. Added reference to CWA training aid on website51. Enhanced graphics in Button/Menu Functions section52. Revised system configuration drawing53. Miscellaneous edits
---------	-------	------	---

Chelton Flight Systems is committed to producing the highest quality product possible; we welcome comments and suggestions concerning this manual. Please e-mail them to support@cheltonflightsystems.com.

Should you encounter problems with the operation of your Chelton EFIS, please complete and return the Service Difficulty Report in the **Appendix** section directly to:

Chelton Flight Systems Inc.
1109 Main St., Suite 560
Boise, ID 83702
OR
Fax (208) 389-9961

Section 2

System Overview

General Description

The FlightLogic synthetic vision EFIS is a complete flight/navigation instrumentation system that intuitively provides information to a pilot via computer generated screens shown on panel-mounted hardware.

The panel-mounted hardware consists of an integrated display unit (IDU) that can be either a Primary Flight Display (that only shows the PFD screen) or a multifunction display (MFD) capable of showing a variety of screens. The MFD can be configured by the pilot as a reversionary PFD or navigation display (ND) at the touch of a button. The ND can be further configured as a moving map, electronic HSI, a dedicated traffic display, or a dedicated weather display.



PFD



MFD

The displays are comprised of a high-brightness backlit LCD screen, eight buttons, two control knobs, and an optional slip indicator. The buttons and slip indicator are also backlit and their brightness can be adjusted independently of the screen. All lighting is night-vision goggle compatible.

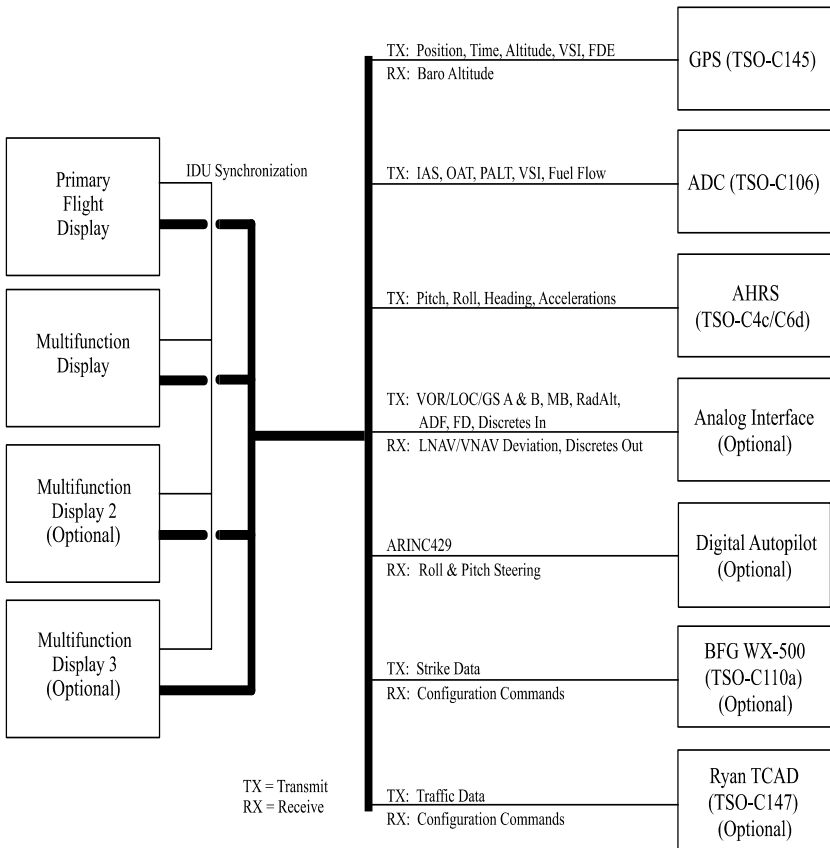
Remote-mounted equipment consists of an AHRS (Attitude/Heading Reference System), an ADC (Air Data Computer), a GPS WAAS receiver, and an optional AIU (Analog Interface Unit).

The fixed-wing FlightLogic EFIS includes integral Class C TAWS (Terrain Awareness Warning System) or, optionally, may include Class B or Class A TAWS. For a detailed description of TAWS functions, refer to the TAWS section in the appendix.

Helicopter systems include Class B helicopter TAWS. Class A helicopter TAWS is available as an option.

System Configuration

Each display is driven by its own internal processor. A complete system consists of at least one display, a GPS receiver, an ADC, and an AHRS. All displays communicate with (but do not rely upon) each other and all sensors are connected to the displays in parallel, so each display is independent from all others and, except for the PFD, can show any page at any time. The data transfer between components, along with the additional equipment that can be interfaced with the EFIS are indicated in the following block diagram.



The systems may be configured with a backup battery on an essentials bus to provide power in the event of an electrical system failure.

In addition, various component failure modes are automatically handled by the software and annunciated to the pilot both visibly and audibly.

Operational Warnings

DO NOT FLY WITH YOUR CHELTON EFIS IF YOU DO NOT FULLY UNDERSTAND EACH WARNING LISTED BELOW:



WARNING!

DO NOT USE THIS SYSTEM FOR TERRAIN-FOLLOWING FLIGHT. DO NOT ATTEMPT TO NAVIGATE USING THE TERRAIN DEPICTION. ALWAYS ADHERE TO PUBLISHED INSTRUMENT APPROACH PROCEDURES IN INSTRUMENT CONDITIONS.



WARNING!

SKYWAY SYMBOLOGY DOES NOT PROVIDE PRECISION APPROACH GUIDANCE NOR DOES IT GUARANTEE TERRAIN SEPARATION. IT REMAINS THE PILOT'S RESPONSIBILITY TO PROVIDE SELF SEPARATION FROM TERRAIN.



WARNING!

DO NOT CONTINUE AN INSTRUMENT APPROACH BEYOND THE DECISION HEIGHT OR BELOW THE MINIMUM DESCENT ALTITUDE UNLESS THE LANDING ENVIRONMENT IS VISIBLE ACCORDING TO THE FEDERAL AVIATION REGULATIONS.



WARNING!

WAAS OR FAULT DETECTION AND EXCLUSION (FDE) MUST BE AVAILABLE AT THE FINAL APPROACH FIX TO CONTINUE AN APPROACH.



WARNING!

DO NOT ENGAGE IN INSTRUMENT FLIGHT UNLESS YOU ARE INSTRUMENT RATED AND CURRENT AND YOUR AIRCRAFT MEETS THE IFR REQUIREMENTS SPECIFIED IN FAR 91.205.



WARNING!

THERE ARE MANY TOWERS, ANTENNAS, AND OBSTRUCTIONS THAT ARE NOT IN THE DATABASE.



WARNING!

THE VFR APPROACH FUNCTION DOES NOT PROVIDE TERRAIN OR OBSTRUCTION CLEARANCE. EXTREME CARE SHOULD BE TAKEN WHEN USING THE VFR APPROACH FUNCTION AT NIGHT OR IN MARGINAL VFR CONDITIONS

Acronyms and Abbreviations

The following abbreviations and acronyms may be used this manual and in the system's user interface.

ACTV - Active
ADC - Air Data Computer
ADS-B - Automatic Dependent Surveillance-Broadcast
AFM - Aircraft Flight Manual
AGL - Above Ground Level
AHRS - Attitude Heading Reference System
AIU - Analog Interface Unit
AMLCD - Active Matrix Liquid Crystal Display
APPR - Approach
APV - Approach with Vertical Guidance
AOA - Angle of Attack
ARINC - Aeronautical Radio, Inc.
ATC - Air Traffic Control
BIT - Built-In Test
CCFL - Cold Cathode Fluorescent
CDI - Course Deviation Indicator
CDTI - Cockpit Display of Traffic Information
CFS - Chelton Flight Systems
CRC - Cyclic Redundancy Check
CWA - Caution/Warning/Advisory
DA - Decision Altitude
DEM - Digital Elevation Model
DH - Decision Height
DL - Data Link
DME - Distance Measuring Equipment
DO - RTCA Document
DOD - Department of Defense
DOF - Digital Obstruction File
DP - Departure Procedure
DR - Dead Reckoning
EFIS - Electronic Flight Instrument System
EGPWS - Enhanced Ground Proximity Warning System
ETA - Estimated Time of Arrival
ETE - Estimated Time Enroute
F/S - Fast/Slow
FAA - Federal Aviation Administration
FAF - Final Approach Fix
FAR - Federal Aviation Regulation
FAWP - Final Approach Waypoint - same as FAF
FDE - Fault Detection and Exclusion
FIS - Flight Information Service
FIS-B - Flight Information Service-Broadcast

FL - Flight Level
FLTA - Forward Looking Terrain Awareness
FMS - Flight Management System
FPM - Feet per Minute
GPH - Gallons per Hour
GPS - Global Positioning System
GPWS - Ground Proximity Warning System
HAL - Horizontal Alert Limit
HAT - Height Above Threshold
HFOM - Horizontal Figure of Merit
HIRF - High Intensity Radiated Field
HPL - Horizontal Protection Level
HSI - Horizontal Situation Indicator
HTAWS - Helicopter Terrain Awareness and Warning System
HUL - Horizontal Uncertainty Limit
IAP - Instrument Approach Procedure, also Initial Approach Point
IAWP - Initial Approach Waypoint - same as IAP
IDU - Integrated Display Unit
IFR - Instrument Flight Rules
ILS - Instrument Landing System
IM - Inner Marker
IO - Input/Output
IPV - Instrument Procedure with Vertical Guidance
KIAS - Knots Indicated Airspeed
KT - Knot - Nautical Mile per Hour
KTAS - Knots True Airspeed
LDA - Localizer-type Directional Aid
LED - Light Emitting Diode
LNAV - Lateral Navigation
LOC - Localizer
LRU - Line Replaceable Unit
MAHP - Missed Approach Holding Point
MAHWP - Missed Approach Holding Waypoint - same as MAHP
MAP - Missed Approach Point
MAWP - Missed Approach Waypoint - same as MAP
MDA - Minimum Descent Altitude
MFD - Multifunction Display (an IDU with software for showing multiple display screens)
MM - Middle Marker
MSL - Mean Sea Level
MTBF - Mean Time Between Failures
ND - Navigation Display
NDB - Nondirectional Beacon
NM - Nautical Mile
NPA - Non-Precision Approach
OBS - Omnibearing Selector
OM - Outer Marker
OT - Other Traffic (Traffic Function)

PA - Proximate Advisory (Traffic Function)
PDA - Premature Descent Alert
PFD - Primary Flight Display (the display screen showing primary instrumentation -- can also refer to the primary IDU with software that only shows primary instrumentation)
PFDE - Predicted Fault Detection and Exclusion
PLI - Pitch Limit Indicator
RA - Resolution Advisory (Traffic Function)
RMI - Radio Magnetic Indicator
RNAV - Area Navigation
RNP - Required Navigation Performance
RVSM - Reduced Vertical Separation Minimums
SA - Selective Availability
SCC - Software Configuration Card
STAR - Standard Terminal Arrival Routes
STC - Supplemental Type Certificate
SUA - Special Use Airspace
SYNC - Synchronize
TA - Traffic Advisory (Traffic Function)
TAS - Traffic Advisory System
TAWS - Terrain Awareness and Warning System
TCAD - Traffic Collision Alert Device
TCAS - Traffic Collision Alert System
TERPS - Terminal Procedures
TCH - Threshold Crossing Height
TD - Traffic Display
TIS - Traffic Information Service
TIS-B - Traffic information Service-Broadcast
TSO - Technical Standard Order
UAR - Unusual Attitude Recovery
USGS - United States Geological Survey
UTC - Universal Time Coordinated
VAL - Vertical Alert Limit
VFOM - Vertical Figure of Merit
VFR - Visual Flight Rules
VHF - Very High Frequency
VNAV - Vertical Navigation
VOR - VHF Omnidirectional Radio
VPL - Vertical Protection Level
VSI - Vertical Speed Indicator
VTF - Vectors to Final
VUL - Vertical Uncertainty Limit
WAAS - Wide Area Augmentation System

Coloring Conventions

A consistent set of colors is used for displaying information on the Chelton EFIS. These colors are detailed as follows:



WHITE is used for scales and associated labels and figures, pilot action, or data entry. Examples:

- Scales markings (airspeed, altitude, heading, VSI, pitch, map ranges, etc.)
- Pilot-selected values (airspeed, heading, altitude)
- Secondary flight data (TAS, wind, OAT, timers, etc.)



CYAN is used for IFR navigation database items (airports with instrument approaches, VOR's, intersections).

CYAN is also used to indicate power-off glide area on the moving map.



MAGENTA is used to indicate electronically calculated or derived data and certain navigation database items. Examples:

- Active waypoint related symbols
- Course data (desired track, CDI)
- VFR airports, NDBs
- HSI



GRAY is used as a figure background for airspeed and altitude readout and for conformal runway depiction (light gray for usable portion of the active runway, dark gray for other runway surfaces).



GREEN is used to indicate normal or valid operation (airspeed, altitude tape coloring, status indication, etc.). Examples:

- Aircraft ground track
- Skyway symbology
- Advisories



DARK GREEN is used in terrain indication on the moving map



yellow is used to identify conditions that require immediate pilot awareness and subsequent pilot action. Examples:

- Caution indications
- Altitude or heading alert
- Component failure indication
- Pitch limit indicator (low-speed awareness)
- Minimum altitude
- CDI needles at full-scale deflection



BROWN is used in a variety of shades to indicate earth/terrain on the primary flight display, altitude tape (ground level and below), and moving map.



BLUE is used in a variety of shades to indicate the sky portion of the primary flight display and bodies of water on the moving map.



RED is used to indicate aircraft limitations or conditions which require immediate pilot action. Examples:

- Warnings (airframe operation limits, terrain awareness)
- Pitch limit indicator (low speed awareness)



Black is used as a background for the moving map, for figures on a gray background, and for outlining certain figures/elements on backgrounds where contrast is minimal

Caution/Warning/Advisory System

The Chelton EFIS includes an integrated auditory caution/warning/advisory (CWA) system that monitors a wide variety of parameters and provides auditory annunciations for conditions that demand pilot awareness. Auditory annunciations take the form of either a voice warning or a chime.

Annunciations are grouped into three categories: warning, caution, and advisory. Warnings are accompanied by a red flag and repeat until acknowledged by the pilot (by pushing the MUTE button on yoke or panel) or the condition is corrected. Cautions are accompanied by an yellow flag and are annunciated once. Advisories are accompanied by a green flag or no flag, depending on condition, and are indicated by either a voice annunciation or a chime.

Annunciation volume is based on level of threat and audio is silenced immediately upon pressing the MUTE button. Overall volume can be adjusted during installation.

CWA Flags are stacked in reverse chronology with warnings displayed on top, followed by cautions and then advisories.

The CWA flags in the following list are prioritized top to bottom according to severity and only the most critical one is invoked.

(Background color indicates flag color. White indicates no flag.)

Condition	Category	Annunciation	Flag
Excessive rate of descent	Warning	"Pull Up, Pull Up"	PULL UP
Excessive closure rate to terrain	Warning	"Terrain, Terrain, Pull Up, Pull Up"	PULL UP
TAWS forward-looking terrain warning	Warning	"Terrain, Terrain, Pull Up, Pull Up"	PULL UP
Obstruction collision hazard	Warning	"Obstruction"	OBSTRUCTION
Airspeed is below the higher of Vs1 or Vs1 corrected for G-loading (not enabled if aircraft has factory stall warning)	Warning	"Stall"	STALL

Condition	Category	Annunciation	Flag
Airspeed above $V_{NE}/V_{MO}/M_{MO}^*$ (Not applicable to Rotorcraft)	Warning	"Overspeed"	OVERSPEED
Aircraft below selected minimum altitude	Caution	"Altitude"	ALTITUDE
TAWS forward-looking terrain caution	Caution	"Caution, Terrain"	TERRAIN
Obstruction collision hazard	Caution	"Obstruction"	OBSTRUCTION
Flight into terrain when not in landing configuration	Caution	"Too Low, Terrain"	TOO LOW
Premature descent	Caution	"Too Low, Terrain"	TOO LOW
500 ft. callout on descent (must climb through 1,000 ft. to enable this function. Not applicable to rotorcraft)	Advisory	"Five Hundred"	No flag
Flight into terrain when gear not in landing configuration	Caution	"Too Low, Gear"	TOO LOW
Flight into terrain when flaps not in landing configuration	Caution	"Too Low, Flaps"	TOO LOW
Excessive rate of descent	Caution	"Sink Rate"	SINK RATE
Excessive closure rate to terrain	Caution	"Caution, Terrain"	TERRAIN
Altitude loss after takeoff or on first leg of missed approach	Caution	"Too Low, Terrain"	TOO LOW
Excessive downward deviation from glide slope on ILS final approach	Warning	"Glide Slope"	GLIDE SLOPE
Excessive downward deviation from glide slope on ILS final approach	Caution	"Glide Slope"	GLIDE SLOPE
Aircraft is descending below 500' and below V_{FE} and any landing gear is not down (enabled only when system is configured for retractable gear aircraft)	Caution	"Check Gear"	CHECK GEAR
Traffic alert (enabled above 400' AGL and only if system is interfaced with traffic detection system)	Caution	"Traffic"	TRAFFIC

Condition	Category	Annunciation	Flag
Fuel quantity in warning range	Warning	"Fuel Low"	LOW FUEL
EFIS core temperature over 95°C	Caution	"EFIS cooling"	EFIS COOLING
Fuel quantity in caution range	Caution	"Fuel low"	LOW FUEL
150' deviation from target altitude	Caution	"Altitude"	ALTITUDE
Deviation of 10 kts. from target airspeed	Caution	"Airspeed"	AIRSPEED
Fuel range less than dest. + 100 miles (not activated in climb)	Caution	"Check range"	CHECK RANGE
Altimeter not set to 29.92 above FL180 (not enabled if set to millibars or hecto pascals)	Caution	"Check altimeter"	ALTIMETER

The flags and annunciations in the following section are NOT prioritized and are invoked simultaneously as applicable in addition to the above.

GPS/WAAS loss of navigation	Caution	"GPS failure"	GPS LON
Dead Reckoning (GPS failure)	Caution	Alert tone	DR ##:## (##:## is the time since GPS loss)
GPS/WAAS loss of integrity	Caution	Alert tone	GPS LOI
No air data	Caution	"Air data failure"	NO AIR DATA
No attitude	Caution	"Attitude failure"	NO ATTITUDE
Radar altimeter invalid	Caution	Alert tone	RADALT
Failure of auxiliary sensor (traffic, weather, etc.)	Caution	"Auxiliary sensor failure"	AUX SENSOR
Outside air temperature probe failure	Caution	Alert tone	OAT SENSOR
Menu lock-out to prevent simultaneous menu actuation on multiple screens	Advisory	None	MENU LOCK
Within 30% of VSI of target altitude (only when vertical speed is greater than 1,000 fpm, inhibited during approaches)	Advisory	"Level off."	LEVEL OFF
ADC not at full accuracy during warm-up	Advisory	Chime	ADC INIT

Condition	Category	Annunciation	Flag
Automatic waypoint sequencing suspended	Advisory	Chime	SUSPEND
GPS/WAAS Parallel offset track selected (## is nautical miles left or right)	Advisory	Chime	PTK = L(R) ##NM
GPS WAAS in IFR approach mode	Advisory	Chime	IFR APPR
GPS/WAAS in VFR approach mode	Advisory	Chime	VFR APPR
GPS/WAAS in terminal mode	Advisory	Chime	TERMINAL
GPS/WAAS vectors to final IFR approach mode	Advisory	Chime	VTF IFR APPR
WX-500 in self-test	Advisory	Chime	WX-500 TEST
HSI and autopilot navigation source	Advisory	None	HSI:X (X = GPS, NAV1, OR NAV2)
Expiration of countdown timer	Advisory	Chime	No flag


AUDIBLE ANNUNCIATION

Throughout this document, auditory annunciations are identified with this speaker icon.



“Practice makes perfect.

To listen to audio samples of all alerts and learn what to do when you hear them in flight, please study the Master Caution System training aid available on our website:

www.cheltonflightsystems.com in the Downloads area.”

Displays

Controls

Each display incorporates eight peripheral buttons (each labeled for a dedicated function) a brightness knob (left side), a menu control knob (right side), and an optional slip indicator. The peripheral buttons and slip indicator are backlit. The buttons are separated by machined “prongs” that isolate the buttons to prevent inadvertent actuation.

There are two kinds of functions: button functions and menu functions. Button functions are activated by pushing a button labeled accordingly. Menu functions are activated by pushing a button adjacent to the desired menu on the screen.





The brightness knob turns clockwise to increase screen brightness and counterclockwise to decrease screen brightness. Pushing the brightness knob while turning adjusts the button and slip indicator brightness in the same manner.



To activate a button function, push the button.

For example, pushing this button activates the Heading Bug function.



To activate a menu function, push the button that corresponds with the menu. To display menus, push the Menu button.

For example, pushing this button now activates the BUGS menu.



When a menu appears in the lower right corner of the screen (see photo on page 2-16), it is controlled with the right-hand knob. Turn the knob to scroll to the desired menu item, letter, or number, then push to select.

If there are no menus shown on the PFD screen, turning the control knob sets the barometric pressure for the altimeter. Pushing it has no function on a dedicated PFD.

Likewise, turning the control knob on the MFD when there are no menus shown sets the scale of the display. Pushing the knob on the MFD instantly brings up a reversionary PFD screen; pushing it again returns to the navigation display.

Once inside the menu structure, the top left button (adjacent to the BACK menu) always takes you back one step in the menu structure. The top right button (adjacent to the EXIT menu) always takes you completely out of the menus.

MENU LOCK

Button and menu input can only be made on one display at a time. When an action is taking place on one screen, the others will display a MENU LOCK flag and the buttons and knobs will not function.

Database and Software Updates

Navigation and Obstruction Databases

The EFIS uses Jeppesen NavData for the navigation database and government sources for the obstruction database.

IFR enroute, terminal, and instrument approach navigation predicated upon the EFIS is prohibited unless the pilot verifies the currency of the database *or* verifies each selected waypoint for accuracy by reference to current published charts.

A SmartMedia data card is used to update these databases. A thin horizontal slot centered in the lower portion of the bezel provides access to the display's data card reader. When the system is powered up with the data card inserted, it enters the ground maintenance mode which provides for system updates.

When inserted, a portion of the data card remains exposed and the card can be removed by pulling on the exposed portion. There is no eject button. A red LED, mounted immediately to the left of the data card slot, provides an indication of when the data card is being accessed.

IMPORTANT: Do not remove the data card when the red LED is illuminated or damage to the data card may result, although it will not cause any damage the EFIS display (it will simply cause the system to restart and enter flight mode).

Only insert or remove the data card with the system powered OFF.

To update the system:

1. If you received your update in the mail, go immediately to Step 2. If not . . .
Using the SmartMedia data card (supplied with your system or available anywhere cameras are sold) log onto the Chelton Flight Systems website (www.cheltonflightsystems.com) and download the current databases by following the instructions in the

DOWNLOADS area (user name and password required;
call 208-389-9959).



DOWNLOADS

PRODUCTS EVENTS ABOUT NEWS DOWNLOADS CONTACT DEALERS HOME

CHELTON
FLIGHT SYSTEMS

Navigation Data Coverage Map

Username

Password

EFIS DATABASE UPDATE TRAINING COURSE
(LOGIN not required to access Training Course)

For 1) Maintenance Technicians servicing part 135 aircraft and/or 2) Operators and Pilots who fly part 91 aircraft equipped with the Chelton Flight Systems FlightLogic EFIS system. Upon completion of this course, you will be certified to perform the Navigation and Obstruction database updating procedures required to keep the EFIS system current for IFR flight.
[\(click here to access Training Course\)](#)

NOTAMS (LOGIN not required to download NOTAMS)

You will need Adobe Acrobat to view the documents. If you don't have Adobe Acrobat, [click here to download](#).

NOTAMS
[NavData](#)

Adobe Acrobat Reader

Terrain Coverage Map 1

Terrain Coverage Map 2

2. With the power OFF, insert the data card containing the databases into the primary flight display (gold side up).
3. Power the system ON and select the **UPDATE DATABASES, LIMITS AND APPLICATION** option using the control knob (turn to scroll, push to enter).

Chelton Flight Systems Ground and Maintenance Functions:

```

Run Demonstrator/Training Program
Update Databases, Limits and Application
Download Log Files
Fuel Tank Calibration (CPU#0 or CPU#1 Only)
View Fuel Tank Calibration Map (CPU#0 or CPU#1 Only)
View bitlog.dat
L3 WX-500 Maintenance Utility (CPU#0 or CPU#1 Only)
Ryan TCAD Maintenance Utility (CPU#0 or CPU#1 Only)
Terrain Data Verification
Display Internal Temperature
Download Routes and User Waypoints
Upload Routes and User Waypoints
View System Limits (CPU#0 or CPU#1 Only)
    
```

4. Power the system OFF and remove the data card
5. Repeat 2 through 4 for each additional display.
6. Upon power up, verify that update was successful by noting the new NavData cycle and expiration dates before acknowledging the startup screen.

The data itself is verified by a CRC-32 self test at every step of the process, thereby ensuring that the data you installed onto the system has not been corrupted at any point during the process.

NOTE:

The system cannot enter flight mode while the data card is in the slot. Inserting the data card in flight has no effect.

Terrain Database Updates

The terrain database is stored on an internal solid-state flash drive. Updating the terrain database requires replacing this drive, which can be done without opening the display enclosure. However, since the display must be removed from its tray to gain access to the drive slot, the terrain database can only be updated by your Chelton FlightLogic dealer or A&P Mechanic.

System Software updates

System software is updated in the same manner as the NavData.

1. Power the system ON and make a note of the software version number before acknowledging the startup screen.
2. Power the system OFF, insert the data card containing the software update into the primary flight display (gold side up).
3. Power the system ON and select the
UPDATE DATABASES, LIMITS AND APPLICATION

option using the control knob (turn to scroll, push to enter).

```
Chelton Flight Systems Ground and Maintenance Functions:

Run Demonstrator/Training Program
Update Databases, Limits and Application
Download Log Files
Fuel Tank Calibration (CPU#0 or CPU#1 Only)
View Fuel Tank Calibration Map (CPU#0 or CPU#1 Only)
View bitlog.dat
L3 WX-500 Maintenance Utility (CPU#0 or CPU#1 Only)
Ryan TCAD Maintenance Utility (CPU#0 or CPU#1 Only)
Terrain Data Verification
Display Internal Temperature
Download Routes and User Waypoints
Upload Routes and User Waypoints
View System Limits (CPU#0 or CPU#1 Only)
```

4. Power the system OFF and remove the data card
5. Repeat 2 through 4 for each additional display.
6. Upon power up, verify that update was successful by noting the new software version number before acknowledging the startup screen.

As with the navigation database, the system software itself is verified by a CRC-32 self test at every step of the process, thereby ensuring that the software you installed onto the system has not been corrupted at any point during the process.

Mechanical Considerations

The displays slide into trays that connect to the aircraft's electrical system and protect the displays from electromagnetic interference, radio frequency interference, high-intensity radiated fields (HIRF), and over/under/reversed supply current. The display's internal power supply filters and converts input supply current to usable and stable voltages at appropriate power levels for internal use. The internal power supply also stores sufficient energy to supply uninterrupted power during momentary power interruptions.

The displays are identical in form, fit, and function. Function is determined by a configuration card ("SCC") mounted in the tray. Therefore, the displays are interchangeable. The optional slip indicator may be interchanged with a blank plug without disassembling the display by removing two screws on the bottom of the device.

Installation and removal of the display is accomplished using a 3/32" hex driver inserted into a hole immediately to the left of the data card slot. The hex driver turns a jack screw that ensures positive engagement or disengagement of the display with the connectors in the tray. This requires about 14 revolutions of the jack screw.

A cooling fan is mounted in a cavity on the back of the display and can be accessed by sliding the display out of the tray and removing the fan cover plate. The fan is serviceable without further disassembly. The fan draws cooling air through slots in the cover plate and through an optional open-cell foam air filter. This filter protects the internal circuitry in dusty environments and can easily be removed, rinsed, dried, and replaced.

The AMLCD (active matrix liquid crystal display) screen is illuminated by a combination of cold-cathode fluorescent (CCFL) tubes arranged in two pairs with each pair driven by its own independent power supply. Typical bulb life is approximately 25,000 hours. The fluorescent bulbs are augmented by LED's for cold-start operation, redundancy, and nighttime dimming capability.

As the screen is dimmed, a flicker and a slight shift in color are normal as the CCFL backlight turns off and the screen is backlit by LED's only. When operated in this range (LED's only), the screens are compatible with night vision goggles.

Although quite rugged, the AMLCD can be damaged. Avoid touching with a hard or sharp object. Wipe water off immediately. Long contact with water may cause discoloration or spots. Clean a soiled screen with an absorbent soft cotton cloth or a "screen prep" pad available at electronics stores.

Attitude/Heading Reference System

Standard AHRS (Crossbow)

The standard system AHRS is a high performance, solid-state attitude and heading reference system (AHRS). This high reliability, strap-down inertial system provides attitude and heading measurement using MEMS (micro-electromechanical sensor) gyros and accelerometers. The information provided by the AHRS is used to drive the Attitude Indicator (Artificial Horizon) and Directional Gyro (slaved) indicator. Thus the AHRS provides the same functions traditionally provided by these two spinning gyros and slaved magnetometer.

An internally computed level platform in the AHRS eliminates all precession errors and gyro tumble conditions. All calibration information is stored internally and used by the internal computer to compensate sensor operation.

The AHRS achieves its excellent performance by employing proprietary Kallman filter algorithms to determine stabilized roll, pitch, and heading angles in static and dynamic conditions. The Kallman filter implementation results in a continuous on-line gyro bias calibration, and an adaptive attitude and heading measurement that is stabilized by the long-term gravity and magnetic north references. The AHRS transmits attitude and heading information to the EFIS on a digital data bus.

The AHRS is remote mounted and designed to meet FAA requirements. A sophisticated suspension system ensures full performance in aircraft vibration environments. A sealed enclosure ensures full performance over full altitude and temperature range without risk of moisture contamination. A comprehensive Built-In Test (BIT) monitors all sensors and internal electronics continuously during operation and sends a system status update to the EFIS 20 times per second.

The maximum roll and pitch rate for the AHRS is 200° per second. On startup, the AHRS performs an extensive self-test

and sensor initialization for 90 seconds. The aircraft must remain stationary during the self-test and alignment initialization (wind gusts and movement within the aircraft will not affect initialization). The EFIS will not display attitude until the AHRS has successfully initialized. It is possible to initialize in flight. To accomplish this, steady, non-accelerating flight should be maintained throughout the initialization period.

In certain installations, an existing ARINC-429 compatible attitude source with demonstrated FlightLogic interface capability may be retained and used in lieu of the AHRS normally included with the system. Consult your installation documents and aircraft wiring diagram for more information.

Optional AHRS

The system may also be configured with a Litef fiber-optic gyro system or Collins AHS-3000 for high-performance applications. Check with your installer to determine the AHRS configured with your system. If you have one of these AHRS, please read the associated Pilot's Guide provided with your system.

Air Data Computer (ADC)

The Airdata Computer is connected to the aircraft pitot and static ports, OAT probe, and fuel system to measure indicated airspeed, pressure altitude, outside air temperature, and fuel flow. From these raw data, true airspeed, and density altitude are calculated for display on the system. These data are also used to calculate the Mach number, winds aloft, fuel endurance, and range. Fuel totalizer functions may not be available on some installations.

In certain installations, an existing ARINC-429 compatible ADC with demonstrated FlightLogic interface capability may be used in lieu of the ADC normally included with the system. Consult your installation documents and aircraft wiring diagram for more information.

NOTE:

A green ADC INIT flag may be present for a few minutes after the EFIS starts operating. This flag will be removed once the ADC has completed its warm-up period. ADC information (airspeed and altitude) may not meet TSO accuracies until this flag is no longer displayed.

NOTE:

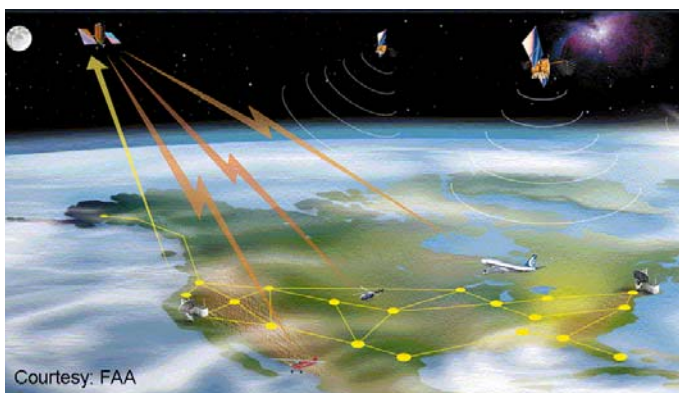
Leaks in the pitot-static system can cause erroneous airspeed, altitude, and winds aloft information. Placement of the static source in the propeller slipstream will result in lower-than-actual altitude and AGL indications on takeoff.

GPS/WAAS Receiver

The Global Positioning System (GPS) is a space-based radio-navigation system. It consists of 24 satellites, which orbit the Earth at an altitude of approximately 11,000 miles, and ground stations. GPS provides users with accurate information on position, velocity, and time anywhere in the world and in all weather conditions

WAAS (Wide Area Augmentation System) is a GPS-based navigation and landing system that will provide precision guidance to aircraft at thousands of airports and airstrips where there is currently no precision landing capability. Systems such as WAAS are known as satellite-based augmentation systems (SBAS). WAAS is designed to improve the accuracy and ensure the integrity of information coming from GPS satellites.

The WAAS is based on a network of approximately 25 ground reference stations. These precisely surveyed ground stations receive signals from GPS satellites and any errors in the signals are identified by comparing GPS-indicated position with the known surveyed position. Each station in the network then relays the error data to one of two wide area master stations where correctional information for specific geographical areas is computed.



A correction message is prepared and uplinked to a geostationary communications satellite. This message is then broadcast on the same frequency as the GPS signal to the GPS WAAS receiver in your FlightLogic EFIS. The WAAS improves basic GPS accuracy to approximately 7 meters vertically and horizontally and provides important integrity information about the entire GPS constellation.

The Chelton FlightLogic EFIS obtains position information from a TSO-C145 Class Gamma 1 GPS WAAS receiver. The GPS sends position, velocity, time, and integrity data to the displays which, in turn, present it as useful position, navigation, and wind information on the PFD and moving map displays. GPS position is also used for terrain awareness alerting (TAWS) functions. GPS status is monitored continuously by the EFIS.



WARNING!

WAAS OR FAULT DETECTION AND EXCLUSION (FDE) MUST BE AVAILABLE AT THE FINAL APPROACH FIX TO CONTINUE AN APPROACH.

If a GPS-related caution flag is displayed, refer to the **FAULTS** menu on the MFD (see **Faults Function, page 4-26**). GPS faults are designated as follows:

1. GPS/WAAS loss of navigation due to absence of power (“GPS PWR”).
2. GPS/WAAS loss of navigation due to probable equipment failure (“GPS EQPMNT”).
3. GPS/WAAS loss of navigation due to inadequate satellites to compute a position solution (“GPS SATLT”).
4. GPS/WAAS loss of navigation due to a position failure that cannot be excluded within the time to alert (“GPS FDE”).
5. GPS/WAAS loss of horizontal integrity monitoring and loss of navigation due to loss of horizontal integrity monitoring (“GPS HLOI”).
6. GPS/WAAS loss of navigation due to no valid WAAS message received for 4 seconds or more (“WAAS MSG”).

7. GPS/WAAS loss of navigation due to insufficient number of WAAS HEALTHY satellites (“WAAS HLTH”).

NOTE:

GPS loss of integrity (GPS LOI flag) is not uncommon and does not indicate a malfunction of the GPS/WAAS receiver or the EFIS. It simply means that the GPS signal from the satellite constellation is not providing a position that is accurate enough to meet FAA standards for sole-source, stand-alone navigation. This is a condition that cannot be detected by non-WAAS GPS receivers.

For more information about GPS failure modes, see **GPS Failure, page 3-129**.

Analog Interface Unit (AIU)

The Chelton Flight Systems AIU provides a data conversion function for the FlightLogic EFIS. The system receives inputs from navigation receivers and radar altimeters and translates them to digital data that is sent to the EFIS. It also translates digital autopilot commands to lateral analog steering signals to allow the EFIS system to command an autopilot system.

Through the AIU, the EFIS can provide lateral commands to any analog autopilot to fly DPs, enroute legs, STARs, approaches (including DME arcs, procedure turns, and holding pattern course reversals), and even missed approaches (including the holding patterns and correct entries) automatically. For non-precision approaches, no pilot interaction is required at any time. For precision approaches, the pilot need only switch the autopilot from HEADING mode to NAV or APPROACH mode just prior to the final approach fix. The EFIS and AIU will allow for all approach procedures to be performed “hands-off.” See **IFR Procedures, page 7-1** for more information.

The AIU has no effect on autopilot pitch or altitude performance.

Input Signals

The following signals are received from various equipment:

- Composite VOR radial/Localizer deviation inputs for two Nav Receivers
- ILS Energize inputs for two Nav Receivers
- DC Glideslope deviation for two Nav Receivers
- Glideslope validity flag for two Nav Receivers
- ADF bearing input for one ADF Receiver in Sin/Cos or ARINC 407 format.
- Marker Beacon inputs for Blue, Yellow and White indications
- Radar Altimeter altitude signal
- Radar Altimeter validity flag
- Flight director vertical deviation
- Flight director horizontal deviation

Autopilot Output Signals

The AIU provides autopilots with:

Analog Vertical Steering (glideslope)

Analog Horizontal Steering (course datum, heading datum, course error).

See **Analog Autopilot Interface, page 5-90** for step-by-step procedures for autopilot usage.

Component Failure Modes

The EFIS continuously monitors attached sensors for receipt of valid data strings and for status information. Should a valid data string not be received within certain time periods, or if the sensor status information indicates a failure, then the associated sensor is considered to be in a failed condition.

Failure of a weather receiver, datalink receiver, TCAS/TCAD receiver, or AIU-1 (Analog Interface Unit) results in the EFIS issuing an yellow caution flag and voice annunciation. None of these receivers or devices significantly impact the navigational or display capabilities of the EFIS.

Failure of the GPS, the AHRS or the ADC, singly or in combination, adversely impacts the EFIS capabilities. These failures are annunciated with yellow caution flags on the MFD and corresponding voice warnings. In addition, the software provides degraded displays to show as much useful and accurate information as possible in the failure condition. These degraded displays are described in detail under **Failure Modes, page 3-126**

Section 3

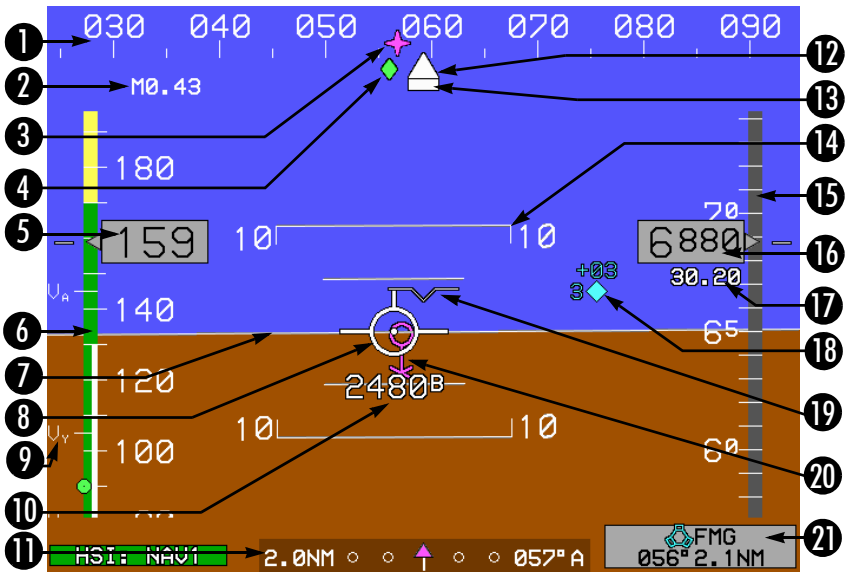
Display Symbology

The following pages detail the symbology used on the various screens. Each screen is mapped with identifiers for each element and the element descriptions follow alphabetically immediately thereafter.

PFD Symbology

The PFD combines analog and digital pitot-static information, heading, attitude, 3-D navigation data, and more overlaid on a “virtual” background of the outside world. Objects shown in the virtual background, including terrain, towers, approaches, and runways, are presented conformally (proper scale and perspective according to the aircraft’s position, altitude, and heading). What is shown on the screen is a replica of a day VFR view out the front window of the aircraft.

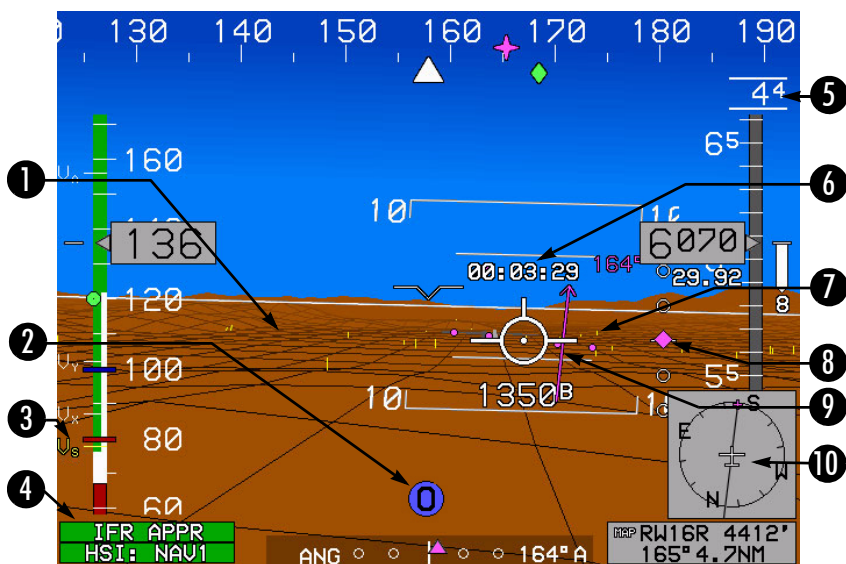
Basic PFD



- | | |
|-------------------------------|---------------------------------|
| 1. Directional scale | 11. GPS/WAAS CDI |
| 2. Mach indication | 12. Heading indicator |
| 3. Bearing to waypoint | 13. Slip indicator |
| 4. Ground track | 14. Pitch scale |
| 5. Indicated airspeed readout | 15. Altitude tape |
| 6. Indicated airspeed tape | 16. Altitude readout |
| 7. Horizon | 17. Altimeter setting |
| 8. Flight path marker | 18. Traffic |
| 9. V-speeds | 19. Waterline |
| 10. Altitude above ground | 20. Active waypoint symbol |
| | 21. Active waypoint information |

Not shown: G-force indicator
Not shown: Flight director
Not shown: Fast/Slow indicator

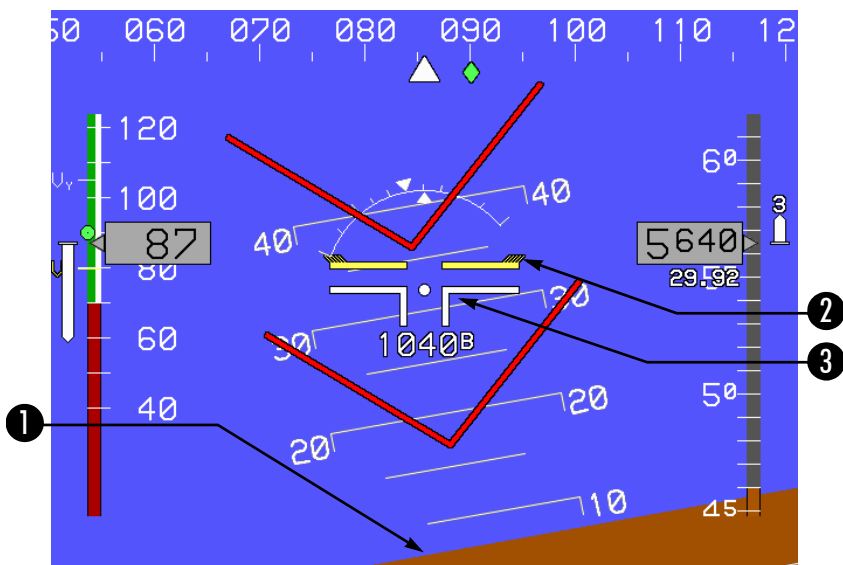
PFD on Approach



1. Terrain
2. Marker beacon
3. Dynamic stall speed
4. CWA flags
5. Target altitude

6. Timer
7. Obstruction
8. Glideslope
9. HSI (Localizer)
10. MiniMap

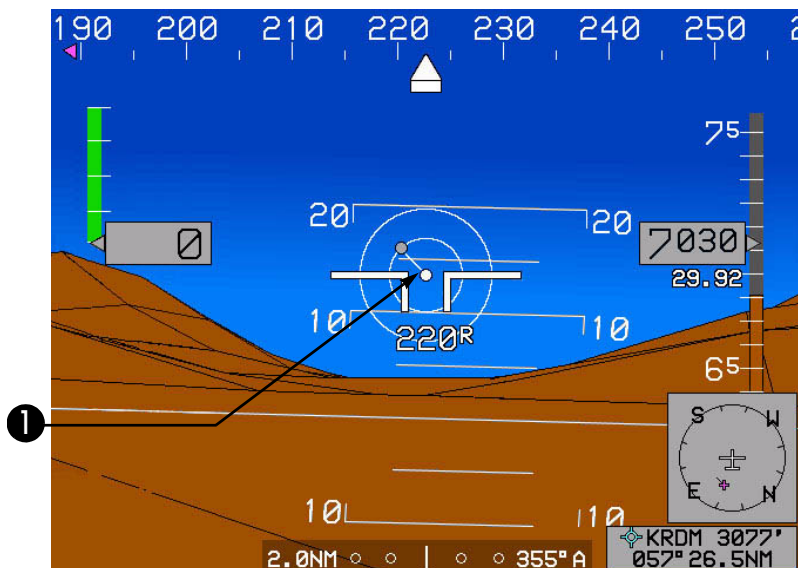
Unusual Attitude Recovery Mode



1. Horizon Cue
2. Pitch limit indicator
3. Expanded waterline

When pitch exceeds $\pm 25^\circ$, the PFD automatically displays the unusual attitude recovery (UAR) mode. In UAR mode, all navigation, terrain, and obstruction symbology are removed. The flight path marker is removed and the waterline is expanded. The pitch limit indicator is retained to provide enhanced low speed awareness, and a horizon cue (a sliver of blue or brown) is always shown to indicate the closest direction to return to straight-and-level flight. Large red chevrons point to the horizon. The display returns to normal at $\pm 5^\circ$ of pitch.

Helicopter PFD



1. Hover Vector

Active Waypoint Information

Information for the active waypoint is shown in the lower right corner of the display. Waypoint information includes waypoint type and identifier, elevation or crossing altitude, bearing, and distance.



Navigation waypoint
symbol conventions

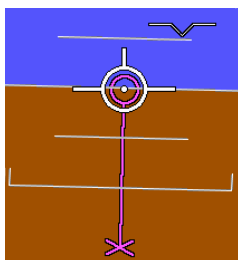
	IFR Airport
	VFR Airport
	VORTAC
	DME Only or TACAN
	VOR Only
	NDB
	Fix
	User Waypoint

NOTE:

See Jeppesen NavData Chart Compatibility in the Appendix for additional information on waypoint naming conventions.

Active Waypoint Symbol

Waypoints (including destination airport) and fixes are displayed as a magenta “tethered balloon.” The “X” on the ground at the bottom of the symbol indicates the waypoint’s conformal (correct perspective) position on the surface of the earth, and the 200 ft. radius hoop at the top indicates the aircraft altitude or target altitude (if target altitude is set). In other words, fly the flight path marker through the hoop and the aircraft will be over the fix at the desired altitude.



The hoop is displayed at the current target altitude and must be set by the pilot. When no target altitude is specified, the hoop is displayed at the aircraft’s current altitude. See **Skyway Vertical Navigation (VNAV)**, page 3-46, for more information.

If you take off from Seattle and your active waypoint is San Diego, you will see the hoop over San Diego on the horizon. Only the active waypoint is shown on the screen. Subsequent waypoints in a route are displayed sequentially as the active waypoint is passed.

NOTE:

Obstruction of the waypoint symbol by terrain means that there is terrain between the aircraft and the obstructed portion of the waypoint symbol.

With terrain turned off, the active waypoint will always be visible regardless of distance.

If the waypoint is beyond the lateral limits of the screen, the magenta waypoint direction pointer on the directional scale will indicate the shortest direction of turn to the waypoint.

If the waypoint is just a hoop hanging in space, that waypoint is a fix not directly associated with a navaid on the ground (such as a VOR, airport or NDB).



“Get the most out of the waypoint symbol:

- 1. If the waypoint hoop is above the artificial horizon, you must climb to go through it; if it is below the horizon, you must descend.*
- 2. Use the waypoint hoop and pitch scale to determine the climb or descent angle required to cross the waypoint at the target altitude. If the hoop is 4° above the artificial horizon, you will have to climb at 4° to go through it.*
- 3. Use the **X** on the ground to do your descent planning. Maintain altitude until the **X** is 2.5° to 3.0° below the horizon (as measured by the pitch scale), then put the flight path marker on the **X**. You’ll enter the traffic pattern at the correct altitude.”*
- 4. **This is very important: If the waypoint **X** disappears behind terrain on the screen, there is terrain in your flight path between you and the airport.***

Waypoint Sequencing

The system defines the desired flight path based upon the active flight plan. The active flight plan can be loaded from a list of stored flight plans or generated using the Nearest function (NRST) or **Direct-To** function, then adding and deleting waypoints en route.

In most cases, the system will auto-sequence from one waypoint to the next, in accordance with the flight plan. Waypoint auto-sequencing will be suspended in the following cases:

1. A manual GPS/WAAS OBS is set (“SUSPEND” flag shown).

2. The aircraft is on the final approach segment of an instrument approach and the missed approach procedure has not been armed by pressing the **MISSED** button (“SUSPEND” flag shown).
3. The aircraft is in a published holding pattern and the pilot has not chosen to continue out of the holding pattern by pressing the **CONTINUE** (“SUSPEND” flag shown).
4. The active waypoint is the last waypoint of the active flight plan (“SUSPEND” flag not shown).

Where automatic waypoint sequencing is suspended, the GPS/WAAS CDI automatically switches from **TO** operation to **FROM** operation when crossing the waypoint.

***AUDIBLE ANNUNCIATION***

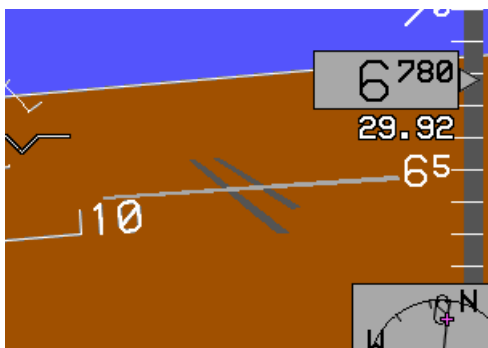
Suspension of automatic waypoint sequencing is annunciated by an auditory chime and an advisory **SUSPEND** flag.

SUSPEND

Airport

On system startup, all runways at the current airport are displayed conformally on the PFD to increase situational awareness. When an IFR approach or STAR is selected at the destination, the runways at that airport are displayed. The usable portion of the active runway is shown in light gray while other runways and unusable portions of the active runway are shown in dark gray.

Since only runways are shown and they will be very apparent on the PFD when approached, this feature is especially useful for avoiding accidental runway incursion during taxi operations.



Altitude Above Ground (AGL)

The estimated altitude above ground level is displayed directly below the flight path marker or expanded waterline any time the indication is 2,500 feet or less. AGL altitude is driven by the AGL altitude source being used for TAWS. A source indication appears after the figure to designate the source as follows:

1. **R** = radar altitude (used when a valid radar altimeter signal is present and shown in 1 ft. increments).
2. **G** = GPS/WAAS geodetic height less database ground elevation (Used when a valid radar altimeter signal is not present and GPS WAAS altitude is accurate within 75 ft. Shown in 10 ft. increments).
3. **B** = barometric altitude less database ground elevation (Used when neither of the above are valid. Shown in 10 ft. increments).

AGL altitude is not displayed when it is greater than 2,500', less than 20', or is invalid. An invalid radar altitude will be annunciated.

Only radar altitude is displayed on helicopter PFD below 200'.

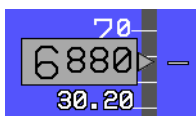
NOTE:

AGL using barometric altitude can only be as accurate as the current barometric pressure setting and is subject to non-standard-day errors. Also, remember that ATIS altimeter setting values are based on the barometric pressure at one particular location on the airport and may be up to one hour old.



Altitude Readout

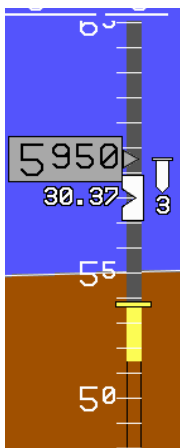
The altitude readout, located approximately two-thirds of the way up the altitude tape, digitally shows barometric altitude in feet MSL. Altitude is displayed in ten-foot increments.



Altitude Tape

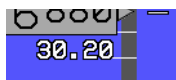
The altitude tape, located on the right side of the display, shows barometric altitude in feet MSL with high numbers toward the top. The portion of the altitude tape that is at and below ground level is colored brown.

The tape is graduated in hundred-foot increments with labels every 500 feet and at least two labels will be visible at all times.



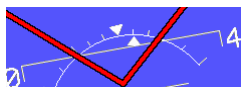
Altimeter Setting (Barometric Pressure)

Current barometric pressure is set using the right-hand control knob and is displayed on the PFD in inches of mercury or millibars.



Bank Angle Scale

A bank angle scale is centered on the flight path marker (or expanded waterline in UAR mode) to display aircraft bank angle. Using the **DCLTR . .** menu, the bank angle scale may be set to appear full-time or auto declutter (shown whenever the aircraft's bank angle is 2.8 degrees or greater). Scale markings conform to conventional artificial horizon standards with graduations at 10, 20, 30, 45, and 60 degrees. A solid white triangle pointed up directly above the flight path marker points to current bank angle. A solid white triangle pointed down is located on the scale at 0°.



Bearing to Waypoint

Bearing to waypoint is shown as a magenta star (waypoint symbol) on the directional scale located directly above the active waypoint.



If the symbol is displaced beyond the range of the heading scale, a magenta pointer on the directional scale indicates the shortest direction of turn to the waypoint bearing.



NOTE:

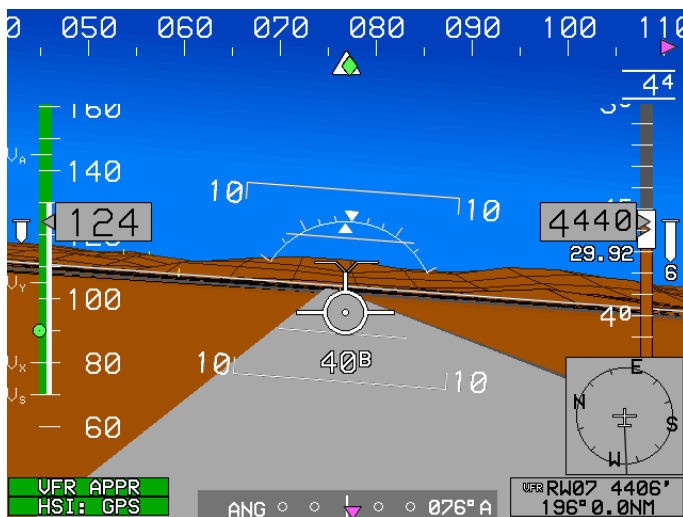
The bearing to waypoint symbol does not indicate the safest way to turn; just the shortest. The pilot must evaluate terrain, traffic, and obstructions before beginning any turn.

Conformal Runway

Runways are displayed conformally – correct location, scale, and perspective with respect to the aircraft’s position, heading, and altitude. Runways at the departure airport are shown automatically. When an IFR approach or STAR is selected, all runways at the destination airport are displayed for added situational awareness.

The usable portion of the selected runway is shown in light gray while other runways and unusable portions of the landing runway (displaced threshold) are shown in dark gray.

Since only runways are shown and they will be very apparent on the PFD when approached (as seen below), this feature is especially useful for avoiding accidental runway incursion during taxi operations.



CWA Flags

The CWA (**Caution/Warning/Advisory**) flags alert the pilot to situations that require pilot awareness. Warnings are indicated by a red flag. Cautions are indicated by a yellow flag. Flagged advisories are indicated by a green flag.

Flags are stacked with warnings on top, followed by cautions, and then advisories. Flags are shown in reverse chronology. For a complete list of flags and annunciations, as well as order of prioritization, see **Caution/Warning/Advisory System, page 2-12**.



AUDIBLE ANNUNCIATION

CWA flags are accompanied by an auditory annunciation.

Directional Scale

A stabilized directional scale is presented across the top of the display. The scale is conformal with the virtual display elements (terrain, waypoints, obstructions, etc.).

For example, an object outside the aircraft that is 10° left of the nose will appear on the display under the heading scale 10° left of the heading pointer. In standard mode, the directional scale is 70° wide and is depicted with graduations at 5° increments and figures at 10° increments. In zoom mode, the directional scale is 35° wide with graduations still at 5° increments (although much more widely spaced).



Dynamic Stall Speed

The stall speed of the aircraft, based on V_s and corrected for normal acceleration (G-load) when greater than one G, is displayed as a dynamic label (**Vs**) that moves up the airspeed tape to indicate the actual stall speed.

Vs is defined as clean stall at gross weight.

Any time the stall speed is greater than the unaccelerated stall speed, the **Vs** is displayed in yellow.



Expanded Waterline

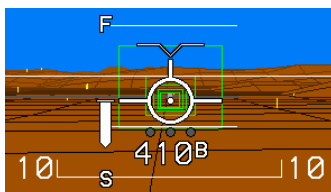
In the unusual attitude recovery mode, the waterline symbol is expanded to provide instant, simple cues for pitch and bank.



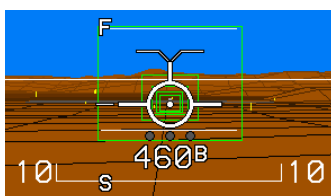
Fast/Slow Indicator

On certain aircraft that are equipped with a compatible angle-of-attack computer, a fast/slow indication is provided on the PFD when the aircraft is in landing configuration. It is displayed to the left of the flight path marker.

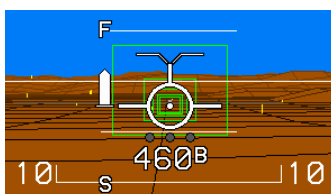
The fast/slow indicator and the G-force indicator are mutually exclusive.



Fast/Slow indicator showing too slow.



Fast/Slow indicator showing on-speed.



Fast/Slow indicator showing too fast.

Flight Director

Conventional dual-cue flight director symbology is available when the EFIS is connected, through the optional AIU analog interface device, to an autopilot that transmits flight director commands. It supports all flight director modes including Take-Off and Go Around.

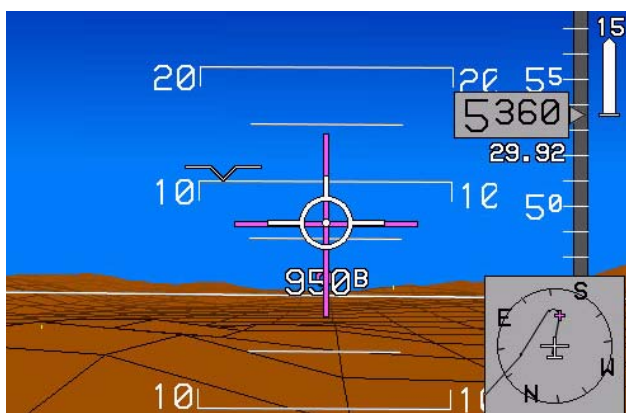
The vertical bar moves laterally and the horizontal bar moves vertically to provide bank and pitch cues generated by the autopilot's flight director computer.

When flown manually, the pilot should apply pitch and bank input to center the needles on the flight path marker. When both needles are centered, the current pitch and bank should be maintained until the needles command a change.

For example, if the horizontal needle is displaced above the center dot of the flight path marker, the pilot should pitch up until the needle is centered, then hold that pitch angle until commanded to change.

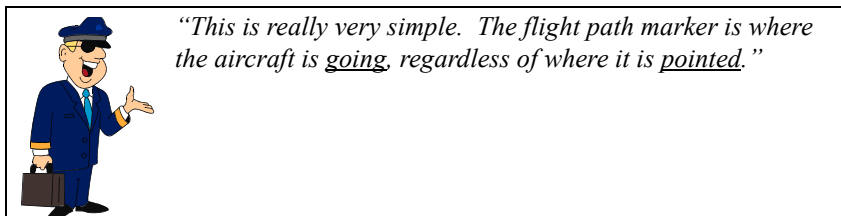
Flight director and HSI symbology on the PFD are mutually exclusive although either can be shown in conjunction with the skyway.

Refer to your autopilot/flight director documentation for more information on flight director functions.



Flight Path Marker

The flight path marker appears conformally on the PFD (coinciding with the aircraft's actual flight path as projected upon the outside world). Thus, the flight path marker is displaced laterally from the waterline to account for the difference between aircraft track and heading (crab angle), and vertically from the horizon to account for aircraft climb or descent angle.



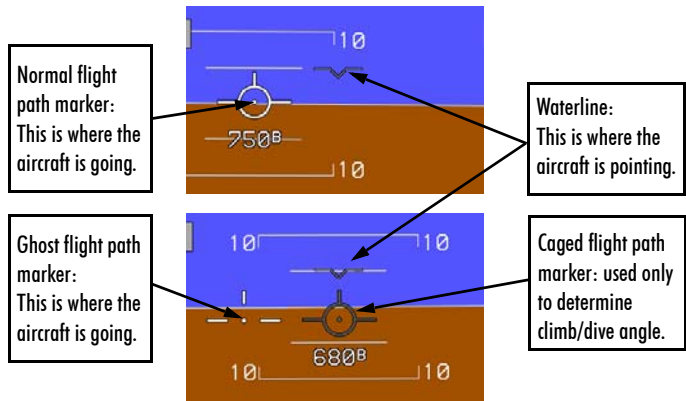
If the flight path marker is superimposed on terrain or an obstruction, the aircraft's current path through the air will result in a collision with that object. Likewise, if the flight path marker is well above terrain in climb, the aircraft will clear the terrain if the current climb angle is maintained. Placing the flight path marker on a waypoint symbol will result in the aircraft flying directly to the waypoint.

Normally, the flight path marker and pitch scale drift around the screen as a single element. When the flight path marker drifts to the edge of the screen due to a crab angle greater than 15° (7.5° in zoom mode), the flight path marker and pitch scale will automatically cage (return to the center of the screen), and a "ghost" flight path marker, represented by three white bars (two horizontal, one vertical), will remain in its place to indicate flight path. The caged flight path marker is grayed out to indicate that it is in the caged position. When the crab angle drops below 13° (6.5° in normal mode), the pitch scale uncages and realigns with the flight path marker.

Caging of the pitch scale and flight path marker is done to preclude clutter and overlapping of other symbols near the edges of the display.

When the flight path marker is displaced beyond the threshold of the viewing area, the ghost symbol will change color to yellow. This will indicate a large crosswind (15° of crab angle) and low ground speed. It could also indicate erroneous heading from the AHRS or erroneous ground track from the GPS.

Below: Normal pitch scale and flight path marker. Note lateral position of flight path marker relative to waterline, indicating a crab angle less than 15° .



Above: Caged pitch scale and flight path marker. Note lateral position of ghost flight path marker relative to waterline, indicating crab angle greater than 15° . Nose position to the right of the flight path marker indicates wind from the right.



“To fly the flight path marker:

Simply position it on the symbol you want to fly to.

If the flight path marker is above the horizon, you are climbing. If it is below the horizon you are descending.

If you want to hit the mountain, put the flight path marker on the mountain. If you want to miss the mountain, put it somewhere else. If the flight path marker cages, use the ghost for getting to the waypoint and use the caged symbol for climb and descent angle.

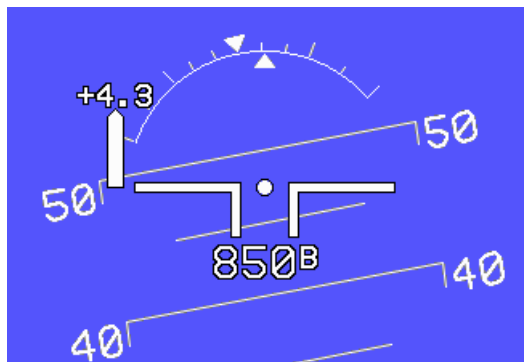
Beware of the YELLOW ghost, indicating displacement beyond the bounds of the screen. If you see this, crosscheck winds, heading, and ground track.”

G-Force Indicator

The G-force indicator is presented as a dynamic pointer that grows out of a fixed datum in correspondence with the amount of G's subjected to the aircraft.

The pointer grows upward from the datum with positive G's and downward with negative G's. The actual G loading is shown digitally at the end of the pointer (example: +4.3 G's).

The G-force indicator is disabled when the difference between G-force and 1-G is less than 0.3 G's. The G-force indicator is damped based upon magnitude and time to prevent nuisance appearances.



Glideslope

See **Localizer/Glideslope (ILS)**, page 3-35.

GPS/WAAS CDI

A CDI is centered at the bottom of the display. The CDI scale and mode are shown immediately to the left and the OBS value and mode are shown to the right.

An arrow pointing UP is a TO indication.

An arrow pointing DOWN is a FROM indication.



The CDI scale is adjusted according to phase of flight:

Enroute (more than 30NM from destination) – 2NM scale

Terminal (within 30NM of destination) – 1NM scale

Approach (within 2NM of final approach fix) – 0.3NM scale

Final (inside FAF) – Angular (like a localizer)

The OBS value is followed by an “**A**” for automatic or an “**M**” for manual. In automatic mode, the OBS displays the course of the active route segment (the magenta line on the moving map).

In manual mode, the OBS displays the pilot-selected course to the active waypoint.

Ground Track

The aircraft’s track over the ground is indicated on the directional scale by a green diamond. Ground track is based on GPS-measurement.



If the ground track is beyond the limits of the directional scale, it will be displayed at the limit of the scale and highlighted in yellow. This situation would be unusual as it would indicate a crab angle greater than 35°.

The ground track symbol is removed below 30 kts.

Heading Bug

The heading bug is a notched, white rectangle (consistent with target altitude and airspeed bugs) displayed on the directional scale.



When the heading bug is displaced beyond the range of the directional scale, the heading bug value is displayed in a box at the limit of the scale.



In this example, the heading bug is set to 210°.

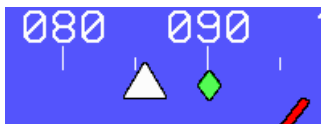
NOTE:

*If coupled with an autopilot in **HEADING** mode, the EFIS will command the autopilot to maintain the selected heading.*

*If the autopilot is flying a flight plan, **invoking the heading bug will override the flight plan** in favor of the selected heading.*

Heading Indicator

The heading indicator is a solid white triangle below the directional scale, pointing upward to the current aircraft heading (where the nose is pointed).



In this example, heading 086°.

Horizon

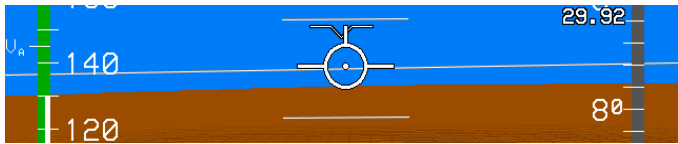
The horizon extends the entire width of the display for enhanced attitude awareness and moves in conjunction with the earth's horizon according to aircraft roll and pitch. There are two components of the horizon symbology, the **artificial horizon** and the **actual horizon**.

The artificial horizon is an edge-to-edge white line that represents the aircraft's level flight path (or current altitude) projected into infinity. It can also be called a zero pitch line. The artificial horizon is used for attitude control and climb/descent angle reference. Objects (waypoint hoops, terrain, traffic, etc.) that appear above the artificial horizon are above the aircraft's current altitude, while those appearing below the artificial horizon are below the aircraft's altitude.

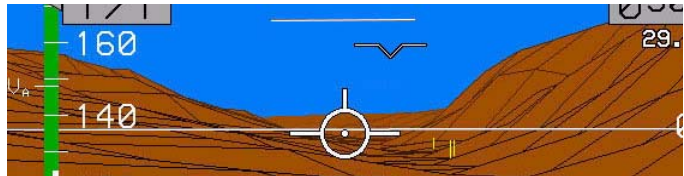
NOTE:

Placing the waterline on the artificial horizon will result in zero pitch. Placing the flight path marker on the artificial horizon will result in level flight.

The actual horizon, as in the real world, is the borderline between ground and sky and can be above or below the artificial horizon. On the PFD, the actual horizon is depicted 40 miles away.



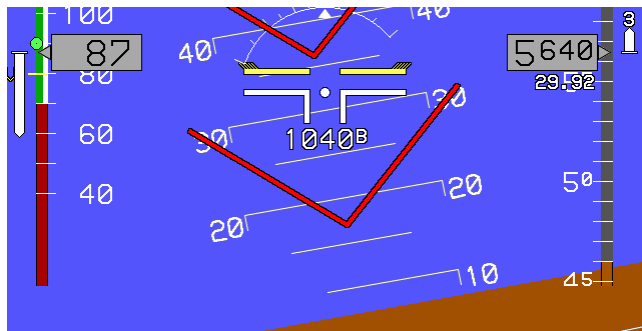
This example shows the artificial horizon and actual horizon over featureless terrain.



This example shows the artificial horizon and actual horizon in mountainous terrain.

Horizon Cue

In the unusual attitude recovery mode, a small strip of blue or brown is left (no matter how extreme the pitch angle) so as to indicate the closest direction to recovery.



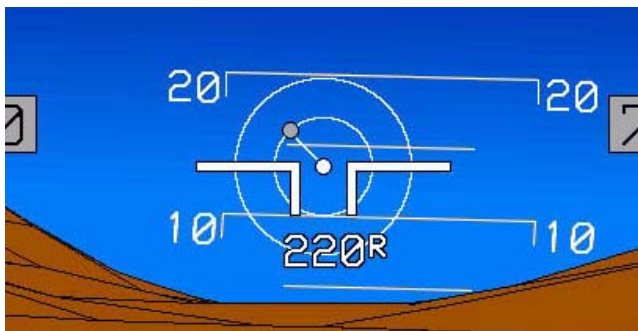
Hover Vector

On a helicopter PFD, whenever the airspeed is below 30 kts., the flight path marker and waterline are replaced with the conventional attitude bars and the hover vector. The hover vector is centered on the attitude bars and is used to indicate direction and groundspeed of drift at low airspeeds.

The inner concentric ring indicates 15 kts. and the outer concentric ring indicates 30 kts. The white dot indicates a still hover. The gray dot indicates the direction of drift, as viewed from above (straight up, the 12:00 position, equates to forward flight while straight down, the 6:00 position, equates to rearward flight). Groundspeed is determined by the location of the gray dot over the concentric rings.

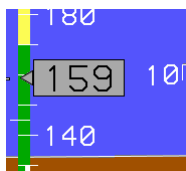
The example below indicates the helicopter drifting forward and to the left (10:00 position) at 15 kts.

AGL altitude below 200 feet is only displayed in conjunction with a valid radar altimeter signal.



Indicated Airspeed Readout

Indicated airspeed is displayed digitally in a gray box overlaying the airspeed tape. Measured in knots or MPH with 1 unit resolution.



HSI

A conventional HSI can be overlaid on the PFD, centered on the flight path marker. The HSI can be driven by Nav 1, Nav 2, or GPS (see **OBS (Omnibearing Selector) Function, page 4-15** or **HSI Source Selection, page 5-63**) and the source is identified as an advisory flag in the lower left corner of the screen.

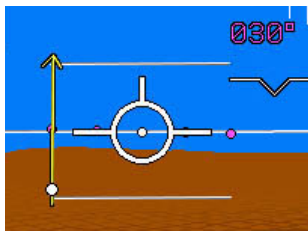
The selected course is displayed in magenta above and to the right of the symbol. The white dot on the courseline arrow provides the **TO/FROM** indication:

A white dot on the arrow side indicates **TO**.

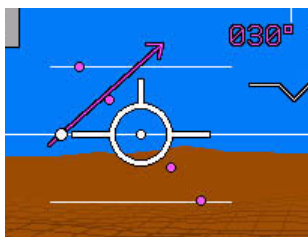
A white dot on the tail indicates **FROM**.

The deviation dots are automatically decluttered when the deviation is less than one dot.

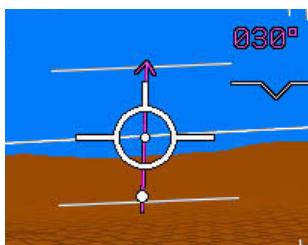
The HSI and flight director symbology are mutually exclusive.



With a selected course of 030°, the needle is at full-scale deflection to the left (indicated on the EFIS by yellow coloration) and the aircraft is on a parallel outbound course.



The needle is alive (indicated on the EFIS by magenta coloration) and the aircraft is on a heading to intercept the 030° course.



In this frame, the aircraft is centered on the 030° course FROM the station (indicated by the white dot on the tail of the courseline arrow).

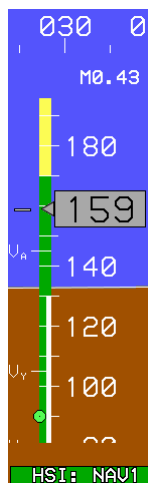
Indicated Airspeed Tape

Fixed Wing (Part 23 aircraft)

The airspeed tape has graduations every 10 knots with labels every 20 knots and high numbers are at the top. Airspeed indication begins at 30 knots. Airspeed tape may be configured during installation to display MPH for aircraft originally equipped that way.

The airspeed tape is colored as follows:

1. A red low-speed awareness area from 0 to V_{S0}
2. A white area from V_{S0} to V_{FE}
3. For aircraft without a V_{MO}/M_{MO} , a green area from V_{S1} to V_{NO}
4. For aircraft without a V_{MO}/M_{MO} , a yellow area from V_{NO} to V_{NE}
5. For aircraft without a V_{MO}/M_{MO} , a red high-speed awareness area from V_{NE} to the top of the scale
6. For aircraft with a V_{MO}/M_{MO} , a red high-speed awareness area from the lower of V_{MO} or M_{MO} to the top of the scale
7. For reciprocating multiengine-powered aircraft of 6,000 pounds or less, a red line at V_{MC}
8. For reciprocating multiengine-powered aircraft of 6,000 pounds or less, a blue line at V_{YSE}
9. A white V_S marking at the aircraft's 1-G V_{S1} or a yellow V_S marking at V_{S1} corrected for G-loading, whichever is higher
10. V_1 , V_R , V_2 , V_{ENR} , and V_{REF} speeds can be set using the **BUGS** . . menu function. V_1 , V_R , and V_2 are automatically disabled when they are exceeded by 40 KIAS or the aircraft climbs above 2,000 ft. AGL. All are set to zero after each flight



11. If enabled, a “green dot” best glide speed marker at V_{GL}
12. If enabled, a white triangle indicates first notch of flaps speed
13. If enabled, a V_X marking at V_X
14. If enabled, a V_Y marking at V_Y
15. If enabled, a V_A marking at V_A

Rotorcraft (Part 27 and Part 29 aircraft)

The airspeed tape has graduations every 10 knots with labels every 20 knots and high numbers are at the top. Airspeed indication begins at 30 knots. Below 30 knots, groundspeed is displayed using the Hover Vector, see **Hover Vector, page 3-30**. Airspeed tape may be configured during installation to display MPH for aircraft originally equipped that way.

The airspeed tape is colored as follows:

1. A green safe operating range area from V_{S0} to V_{NO} .
2. A yellow caution range area from V_{NO} to V_{NE} (power-on)
3. A red high-speed awareness area from V_{NE} to the top of the scale
4. A red cross-hatched line at V_{NE} (power-off)

Localizer/Glideslope (ILS)

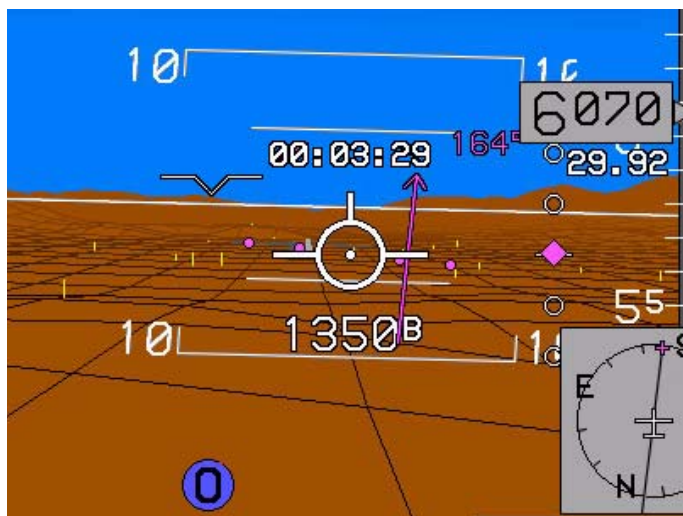
Localizer and glideslope are displayed on the PFD using conventional symbols that move in conjunction with the flight path marker whenever valid localizer and glideslope signals are present.

The localizer centers on the flight path marker and the glideslope is displayed immediately to the right. Unlike the HSI symbol on the PFD, the localizer course needle has no TO/FROM indication (white dot).

Localizer deviation dots are automatically decluttered when the needle is within one dot of centered. At full-scale deflection, the localizer and glideslope indicators will be displayed in yellow.

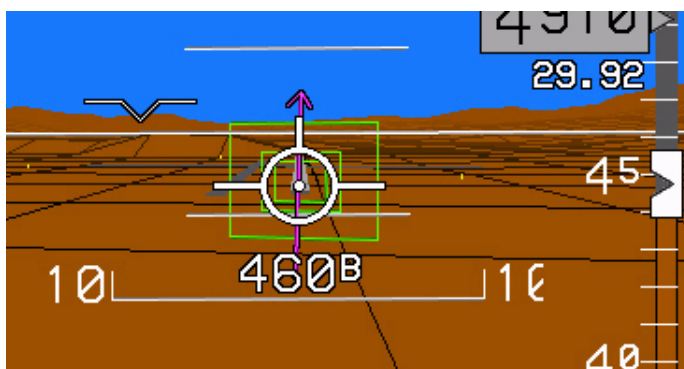
ILS symbology is enabled on the PFD by choosing HSI in the **DCLTR** . . menu and can be shown with or without the skyway. The system auto detects the presence of VOR or ILS signal and displays the appropriate symbology. No valid signal results in no symbology.

The nav source driving the ILS symbology is annunciated by a green advisory flag in the lower left corner.



The localizer may be automatically set to the final approach course by pressing the SYNC button in the nearest ILS function.

For localizer-only (no glideslope) display, only the localizer needle is displayed. The HITS will continue to provide barometric vertical navigation to the missed approach point. When flying a localizer backcourse, the glideslope symbology is automatically removed to prevent display of false glideslope activity.



“Remember, the skyway is always driven by GPS for lateral and barometric altitude for vertical while the localizer and glideslope are always driven by the ILS so you have a continuous cross-check of independent sources centered in your scan. The conformal runway presentation is a powerful aid when flying an ILS; keeping the flight path marker on the near end of the runway will result in very precise ILS tracking.”

Mach Indicator

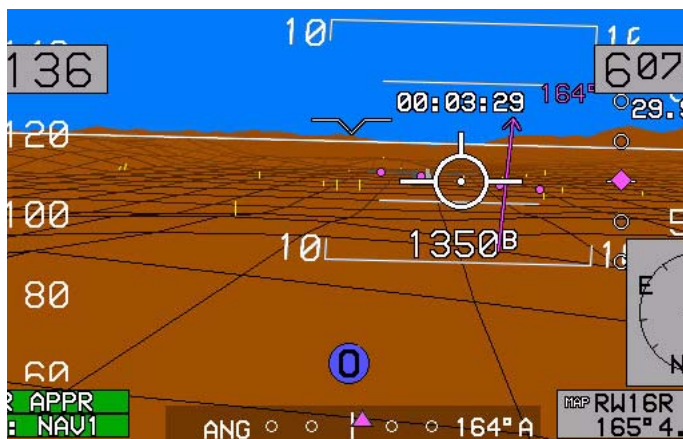
The Mach number is shown as an installation option above the airspeed tape the airspeed indicator. It is automatically removed below Mach 0.35.



Marker Beacon

Conventional marker beacon indicators are shown centered in the lower portion of the PFD, just above the CDI.

Marker beacons will only be shown when a marker beacon receiver is connected to the EFIS through the optional AIU analog interface device.

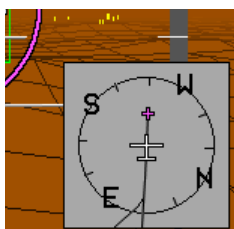


MiniMap

The MiniMap graphically shows the aircraft's position relative to the active waypoint and route segment in a heading-up orientation.

The MiniMap has no specific scale; it is used for general situational awareness, presenting a simplified, miniature view of what is shown on the navigation display.

The MiniMap's compass rose has graduations at 30° increments and labels for north, south, east, and west. The active waypoint is shown as a magenta “+” symbol. The line through the waypoint symbol represents the selected course leg. If an instrument approach is selected, the MiniMap displays the entire approach procedure up to the missed approach point. When a missed approach is activated, the MiniMap depicts the entire missed approach procedure.



The MiniMap is only displayed when there is an active waypoint.

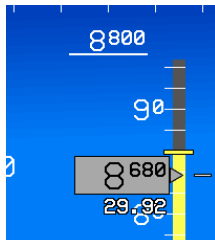
Minimum Altitude Bug

When a minimum altitude is selected, a bug in the form of a bold yellow bar is displayed in the appropriate position on the altitude tape, and the tape below the tick is colored yellow. Minimum altitudes can be set in 10-foot increments.



Minimum Altitude Setting

When a minimum altitude is selected, the setting is indicated above the altitude tape. A minimum altitude value is identified by a line immediately below it. Minimum altitudes can be set in 10-foot increments. The default entry for the minimum altitude is 1,000 ft. above the runway.



This example shows a Minimum Altitude Setting of 8,800 ft.



AUDIBLE ANNUNCIATION

When a minimum altitude is set, descending below it causes an annunciation of “Altitude”

ALTITUDE

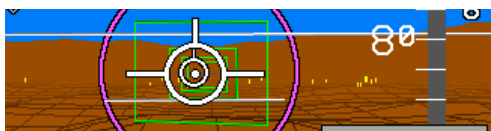
Obstructions

Towers, antennas, and other obstructions are shown on the PFD as vertical yellow lines.

Obstructions are conformal in both location and size (a tower shown 10° left of heading and below the horizon line on the screen will be seen outside 10° left of the aircraft's nose and below the current altitude).

Obstructions are only shown in conjunction with terrain and regardless of aircraft altitude.

Obstructions that represent a collision hazard are annunciated aurally and with a caution or warning flag.



WARNING!

THERE ARE MANY TOWERS, ANTENNAS, AND OBSTRUCTIONS THAT ARE NOT IN THE DATABASE.

NOTE:

The obstacle database is as current as possible but obstacles are erected almost daily so not all obstacles can be displayed or will generate a warning. Typically, very tall obstacles are current and new ones are infrequent. Smaller towers such as cell phone towers are erected daily and represent hazards that cannot be kept current in any database.



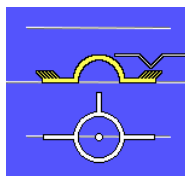
AUDIBLE ANNUNCIATION

Towers, antennas, and obstructions that represent a collision hazard cause an annunciation of "Obstruction."

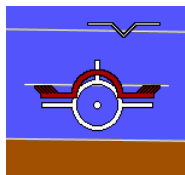
OBSTRUCTION

Pitch Limit Indicator

The optional (set during installation) pitch limit indicator (PLI) is a winged symbol that appears above the flight path marker and moves downward as the aircraft approaches stall speed. The PLI enhances low speed awareness. The PLI is based on **V_{S1}** (clean stall, gross weight) and is G-load compensated above one G.

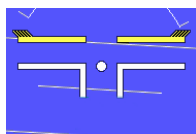


The PLI first appears in yellow at 20 knots above G-corrected **V_S** and moves downward as airspeed decreases.

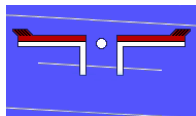


The PLI turns red at 5 knots above G-corrected **V_S** and activates the STALL voice warning if enabled.

In unusual attitudes (beyond $\pm 25^\circ$ pitch), the flight path marker is removed and the waterline is expanded. The PLI is displayed relative to the expanded waterline.



Unusual attitude PLI appears in yellow at 20 knots above G-corrected **V_S** and moves downward as airspeed decreases.



Unusual attitude PLI turns red 5 knots above G-corrected **V_S** and activates the STALL voice warning if enabled.

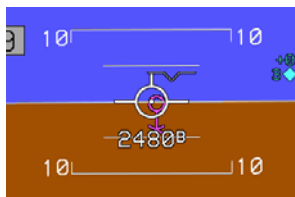


“To use the pitch limit indicator:

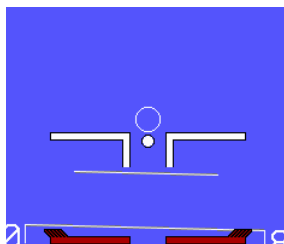
Think of it as a low-speed awareness cue; don't let it settle on the flight path marker or attitude bars and you won't stall the aircraft. But remember, since it is based on the clean stall configuration, it is not a stall warning and will turn yellow or red during a normal landing as the speed decays.”

Pitch Scale

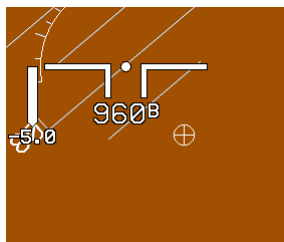
The pitch scale rotates in conjunction with the horizon according to the aircraft's roll angle. The graduations on the pitch scale are spaced to conform with the background. It may be set to be displayed full time or to auto-declutter when wings-level.



The pitch scale is truncated, only showing 10° beyond the flight path marker or waterline, whichever is further from the artificial horizon. The pitch scale has graduations every 5° and labels every 10°. Tick marks at the ends of each numbered pitch scale graduation indicate the direction to the horizon.



The pitch scale terminates with a zenith symbol (hollow circle) at 90° up.



The pitch scale terminates with a nadir symbol (circle with cross) at 90° down:

Skyway

The PFD displays the active navigation route or manual OBS course in a three-dimensional manner using a series of skyway boxes (commonly referred to as HITS or Highway-In-The-Sky). The skyway boxes overlay the flight plan route at a desired altitude providing lateral and vertical depiction of the desired flight path.

The skyway is displayed whenever a waypoint, runway, or any approach/departure procedure is selected. The skyway shows the course that you have selected and can be thought of as a predictive flight director because it indicates upcoming maneuvers.

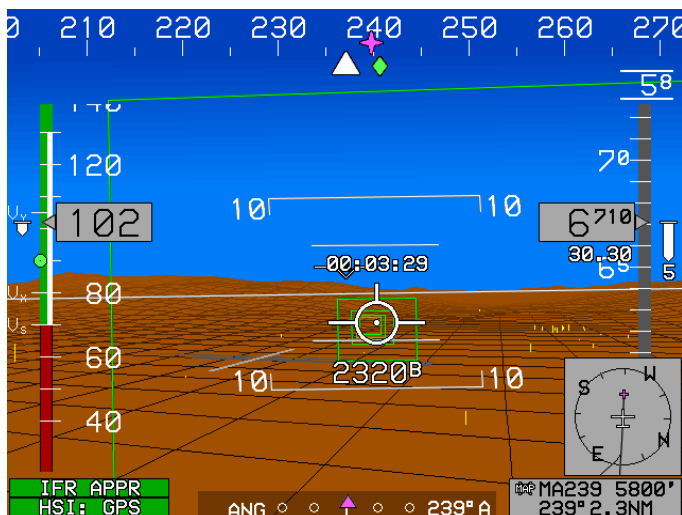
The skyway boxes are centered on the active leg of the route. When the active leg of the route is within the field of view on the PFD, five boxes are shown. If the active leg of the route is not in PFD's field of view, the skyway will not be visible.

The boxes are spaced 2,000 feet apart and always measure 320 feet high by 400 feet wide. For comparison, an ILS localizer is 700 feet wide at the runway threshold.

NOTE:

The skyway boxes are drawn using a hidden surface removal techniques such that a skyway box behind terrain will appear to be so.

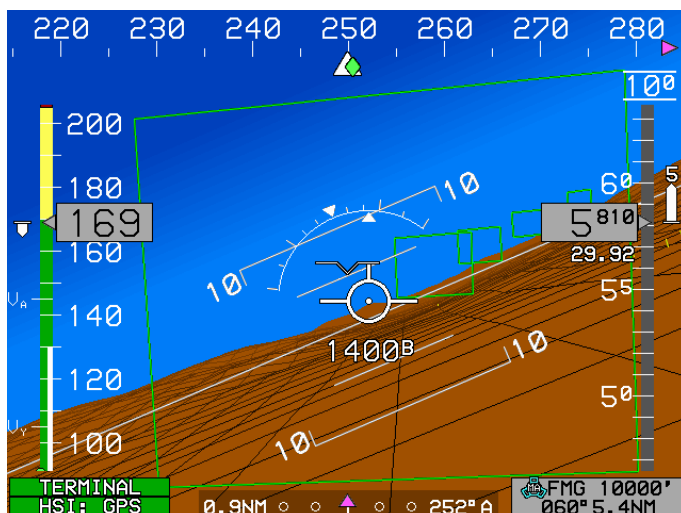
The skyway boxes may be removed from the screen using the **DCLTR . .** menu.



Skyway as seen on final approach (circle-to-land; active runway is light gray).

Skyway Lateral Navigation (LNAV)

The skyway starts at the beginning of a route or flight plan and terminates at the destination or, if an instrument approach is selected, at the missed approach point. Arming the missed approach procedure (simply pushing the **MISSED** menu button) causes the skyway to follow the missed approach procedure. It will automatically calculate the entry to the hold (parallel, teardrop, or direct) and then hold as published at the missed approach holding fix.



Skyway as seen while executing a missed approach (climbing right turn).

Skyway turns requiring more than 5° bank angle are indicated by boxes banked 15° in the direction of the turn, while turns requiring less than 5° bank angle are unbanked.

For example, a holding pattern or procedure turn will have banked boxes indicating the turn, while a 15-mile DME arc will have unbanked boxes because it is a very gradual turn along the arc.

The system is configured with a **V_{PROC}** or preprogrammed speed to determine the radius of the skyway turns in a procedure. **V_{PROC}** is the approximate speed that approach procedures are typically flown in a particular aircraft. Skyway turns will result in 15° banks at that speed. **V_{PROC}** is used on:

1. the first two waypoints in a DP,
2. STAR waypoints within 30NM of the destination,
3. IFR approach and missed approach procedures.

Otherwise, turn skyway turn radius is based on a 15° bank at the higher of the preprogrammed **V_{PROC}** or current speed.

Therefore, in zero-wind conditions, the angle of the flight path marker will match the angle of the boxes. However, wind will cause the actual bank angle required to stay within the skyway to vary.

Due to the fact that five boxes are shown ahead of the aircraft, upcoming turns are apparent well before turn input is required, thus they become an anticipatory cue for the pilot. The pilot always has a clear understanding of what will happen next along the course.



“To fly skyway turns:

Wait until you fly through the last level box on a straight course segment before initiating your turn. If you overshoot the next box, just increase your bank angle slightly. If you undershoot the next box, shallow your bank angle a bit. You can check your progress through a turn by looking at the projected path on the moving map; just make it match the curve of your courseline. And remember, the boxes indicate a turn radius, not a target bank angle - because of the effects of wind.”

Skyway Vertical Navigation (VNAV)

Skyway box altitude is controlled by target altitude, aircraft altitude, aircraft climb performance, and climb/descent angle setting. If no target altitude is set, then the skyway boxes describe the desired lateral flight path of the aircraft at the aircraft's current altitude. With a target altitude set, the boxes provide both lateral and vertical guidance. Climb and descent angle settings are controlled individually with a resolution of 0.1° using the **VNAV CDA** function in the **BUGS . .** menu, see **Bug Set Function, page 4-21**.

Climbs

When the active waypoint is part of a procedure, the system expects the altitude constraint for that waypoint to be provided by the navigation database. Where a procedure altitude constraint exists, the target altitude is set automatically. Where

a procedure altitude constraint does not exist, the system looks ahead in the procedure for additional altitude constraints. If a further altitude constraint is found and it is above current aircraft altitude (a climb is necessary), then a target altitude is continuously calculated for the active waypoint based upon an immediate climb to the altitude constraint at the higher of

- 1) the aircraft's actual climb angle or
- 2) the climb angle setting ("dynamic climb angle").

If a further altitude constraint is found and it is below current aircraft altitude (a descent is necessary), then a target altitude is automatically set for the active waypoint based upon a descent to reach the target altitude at the waypoint using the descent angle setting.

If no further altitude constraints are found, then the target altitude is simply set automatically from the procedure database.

At any time, the pilot may override the automatic target altitude by manually setting the target altitude bug.

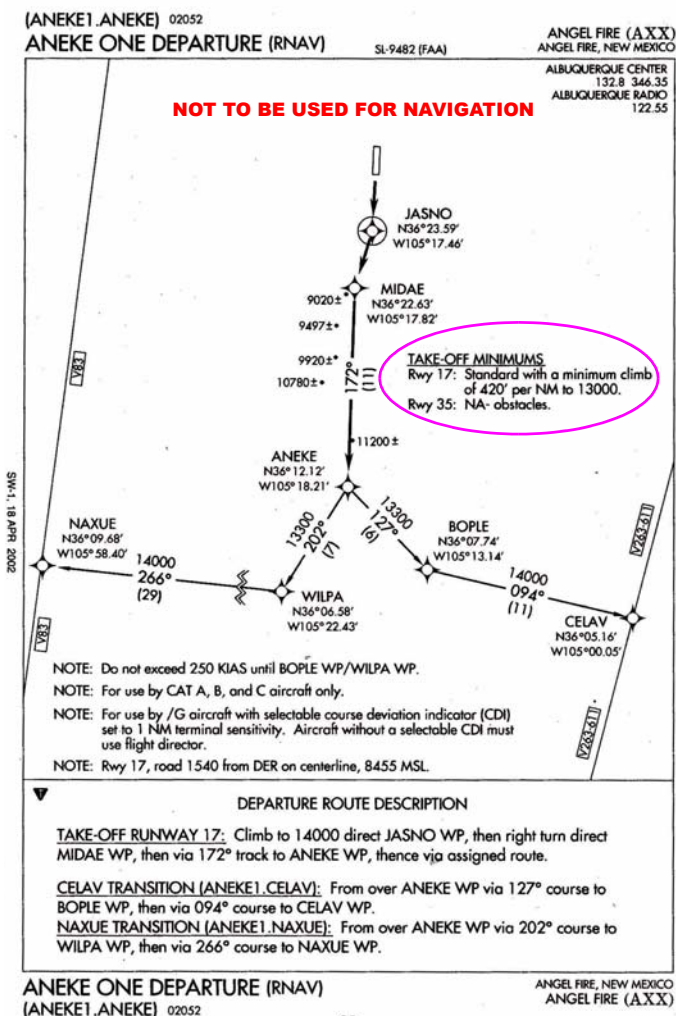
When the aircraft is below the target altitude (a climb is desired), the boxes are drawn at a vertical position that is the higher of

- 1) the dynamic climb angle emanating from the aircraft's present position (aircraft-referenced)
- 2) the dynamic climb angle emanating from the next waypoint altitude (geo-referenced forward)
- 3) the climb angle setting emanating from the previous waypoint altitude (geo-referenced backward).

The geo-referenced backward method is only considered when the current leg is part of a procedure and is designed to provide pilot awareness if a specified climb gradient is not being met (a missed approach in a mountainous area, for example). Once the boxes intercept the target altitude, further boxes are drawn with a zero angle to indicate a level-off. Due to the fact that five boxes are shown, the level-off depiction becomes an anticipatory cue for the pilot.

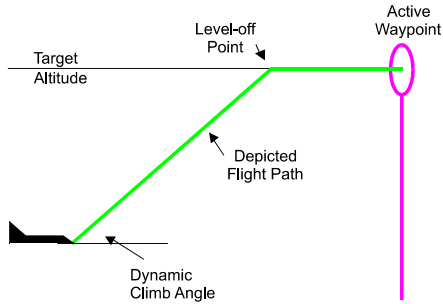
NOTE:

Be sure to set the climb angle (ft./NM) required for a departure procedure (from the DP plate as shown below) using the VNAV climb angle setting under the **BUGS . .** menu.

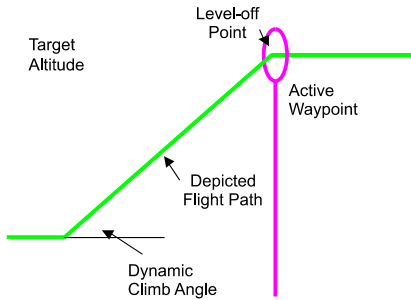


Climb guidance is depicted as follows:

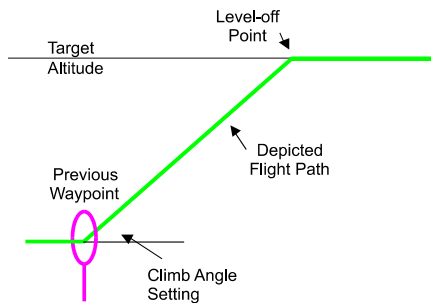
Aircraft-Referenced Climb



Geo-Referenced Forward Climb



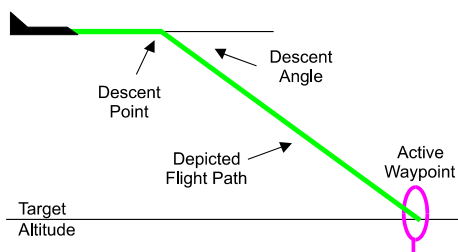
Geo-Referenced Backward Climb



Descents

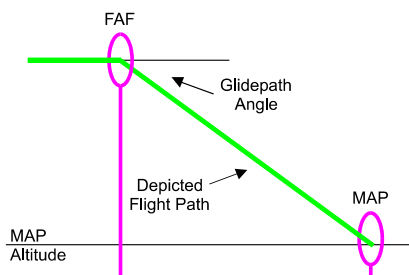
When aircraft altitude is above the target altitude (a descent is desired), the boxes are drawn with a zero angle until reaching a descent point. Further boxes are then drawn downward at an angle corresponding to the descent angle setting. The descent point is determined by the intercept of a line emanating upward from the active waypoint at the descent angle setting, and a line representing level flight at the aircraft's current altitude.

Normal descent



On the final approach segment of an IFR or VFR approach procedure, the descent point is the Final Approach Fix and the descent angle creates a stabilized approach to the Missed Approach Point location and altitude as stored in the navigation database. Due to the fact that five boxes are shown, the descent point depiction becomes an anticipatory cue for the pilot.

Final approach segment



During a steep descent, if the aircraft descends below the boxes, they will rejoin the aircraft upon reaching the target altitude.



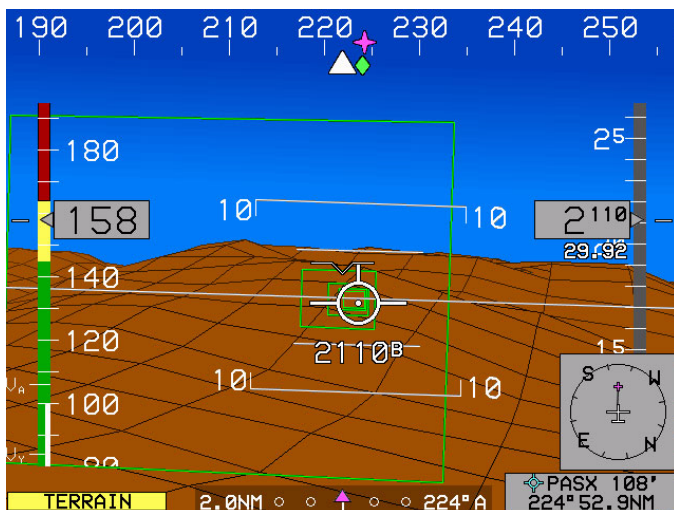
“What does all that mean?”

*This description of the VNAV operation explains how the system thinks. It provides safe and conservative climb and descent guidance from takeoff to touchdown. What you really need to remember is **fly the boxes**, unless you purposefully decided to descend beneath them - if you do, they'll catch up with you when you level off. Also, don't forget to set the climb gradient for a DP using the **Bugs . .** menu. Generally, the **HITS** will do what you want but remember, as the pilot, you can set any target altitude you want.”*

Flying the skyway

Because of its visual 3-D nature, flying the skyway is easy, like driving down the road (you don't need needles or command bars to tell you how to stay in the center of your lane). The boxes indicate the path through the air you want to take and the flight path marker indicates the path through the air you are actually flying. Simply fly the flight path marker through the boxes; wind is accounted for automatically. If you find yourself drifting out of the boxes, simply drift back to the center, like you would on the road in your car. Also, just like in your car, don't make large corrections or you will S-turn along the course; for straight segments, bank angles greater than 3° are excessive.

It is important to recognize that the skyway does not provide approved precision vertical instrument approach guidance, nor does it guarantee terrain separation. As with any navigation device, including VOR's, it is possible to generate course guidance that will impact terrain as shown in the following example:



In this circumstance, however, the compelling nature of the forward-looking terrain display combined with the advanced TAWS capabilities will provide the pilot with the situational awareness to recognize the hazard and take the appropriate corrective action.



WARNING!

SKYWAY SYMBOLOGY DOES NOT PROVIDE PRECISION APPROACH GUIDANCE NOR DOES IT GUARANTEE TERRAIN SEPARATION. IT REMAINS THE PILOT'S RESPONSIBILITY TO PROVIDE SELF SEPARATION FROM TERRAIN.



“The key to successfully flying the skyway is:

1. *When flying straight and level, don't try to steer through the nearest box. Aim for the smallest box you can see and make tiny corrections, like you are flying an ILS.
Remember, 3° is too much bank.*
2. *Don't overcontrol; once established in the skyway and trimmed correctly, your aircraft will fly a long way in the boxes without any “help” from you.*
3. *When turning, if you find yourself turning inside or outside the turn radius indicated by the skyway, relax and simply increase or decrease your bank angle slightly. If you look down at the CDI, it will probably be nearly centered (unlike a VOR/LOC the CDI provides course deviation indication throughout turning maneuvers, as well as for straight segments). Remember, the skyway is only half the width of the localizer at the inner marker making it very precise, so if you are a bit inside or outside, you are still flying with extreme precision. Do not fixate on flying through the center of the boxes prior to the final approach fix.*
4. *When joining the skyway at an angle, think of it as merging onto the freeway using an on-ramp. Join up gradually and make small adjustments.*
5. *If you ever lose track of the skyway, simply look at the moving map and locate the active (magenta) leg of your course. The skyway will be located along that course line. If you are on the magenta line and the skyway is not visible, it is probably above or below you based on your target altitude setting.*
6. ***Pay attention to where the skyway is taking you; if you don't like the looks of it, don't go there.”***

Slip Indicator

An electronic slip indicator is provided and may replace the mechanical slip indicator mounted in the bezel.

The slip indicator is a rectangle just below the heading pointer that moves left and right to indicate the lateral acceleration sensed by the AHRS in the same manner as the ball in a mechanical slip indicator.

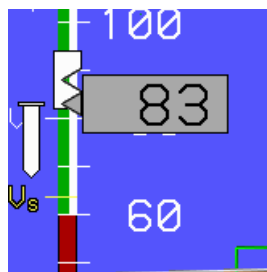


Speed Trend Indicator

The Speed Trend Indicator is presented as a dynamic pointer that grows out of a fixed datum in correspondence with changes in horizontal velocity.

The pointer grows upward from the datum when accelerating and downward when decelerating.

The pointer tells the pilot what the aircraft's velocity will be in five seconds.



The above example shows that the aircraft will be at approximately 68 KTAS in five seconds.

Target Airspeed

The current target airspeed is displayed in conjunction with the target airspeed bug immediately above the airspeed tape. The value is bracketed by lines above and below.



In this example, the target airspeed is set to 88 kts.



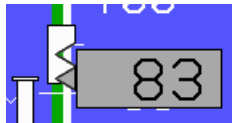
AUDIBLE ANNUNCIATION

When a target airspeed is set and has been reached, deviation of more than 10 kts. will result in a yellow flag and a voice warning of “Airspeed. Airspeed.”

AIRSPEED

Target Airspeed Bug

A bug marking the target airspeed is displayed on the airspeed tape. The bug moves up and down the tape as the control knob is rotated.



Target Altitude

The target altitude is displayed above the altimeter tape and is bracketed by a line above and below. Target altitude is settable with a resolution of 100 ft. enroute and in terminal mode, and 10 ft. in approach mode.



In this example, target altitude is set to 9,200 ft.



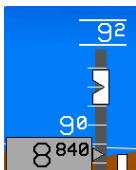
AUDIBLE ANNUNCIATION

When a target altitude is set and has been reached, deviation of more than 150 feet will result in a single annunciation of “Altitude. Altitude.”

ALTITUDE

Target Altitude Bug

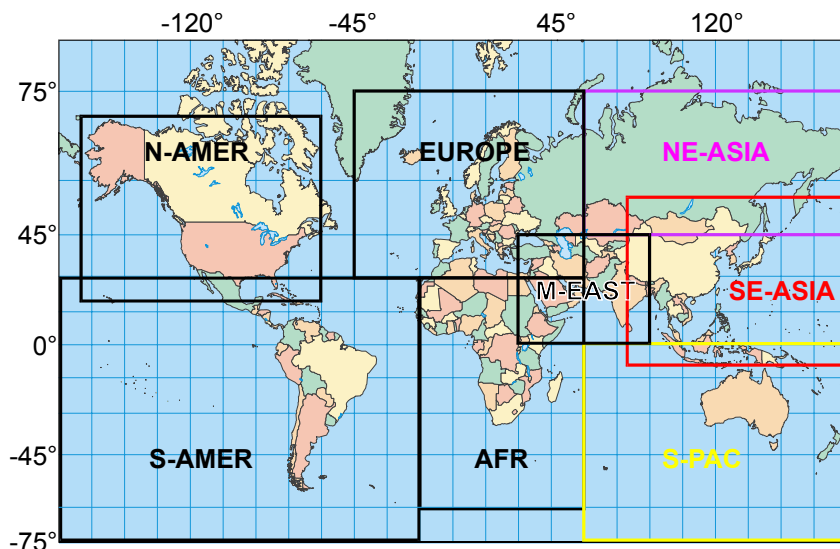
A bug marking the target altitude is displayed on the altitude tape. The bug moves up and down the tape as the control knob is rotated. Target altitudes are also set automatically for waypoints during procedures.



Terrain

The terrain ahead of the aircraft is shown conformally with the artificial horizon and in the correct scale and perspective for the aircraft's current position and altitude.

Worldwide terrain coverage is provided and is grouped into regions as follows:



Each of the the above regions is stored on a single terrain data card, which is installed in each display. Each system comes loaded with one terrain region. Terrain cards may be changed in minutes by your Chelton FlightLogic dealer or A&P Mechanic.

Terrain is shown with a resolution of 24 arc seconds, which represents about 2,400 feet.

Terrain is displayed 14 miles ahead of the aircraft using a grid and simulates “atmospheric perspective,” meaning that the terrain lines fade into the background “ground” color as they recede into the distance. This enhances the three-dimensional effect, improves distance judging, and minimizes foreground occlusion (objects in the foreground that cannot be seen against

a similar background). Furthermore, a 40NM actual horizon is depicted.

Threatening terrain will cause a “pop-up” condition on both the PFD and first MFD in a system meaning that, even if it has been manually decluttered by the pilot, terrain will automatically be shown on the displays when it becomes threatening.

A blended-tone sky is displayed in conjunction with terrain. The sky fades from light blue at the horizon to dark blue at the top of the display to simulate atmospheric perspective and enhance the 3-D presentation. Additionally, the blended sky increases contrast of the directional scale, emphasizes the horizon, and provides a compelling visual cue to a nose-high attitude.

If a runway or the “x” at the bottom of the waypoint symbol is obscured, then there is terrain between the aircraft and the runway or waypoint at ground level.

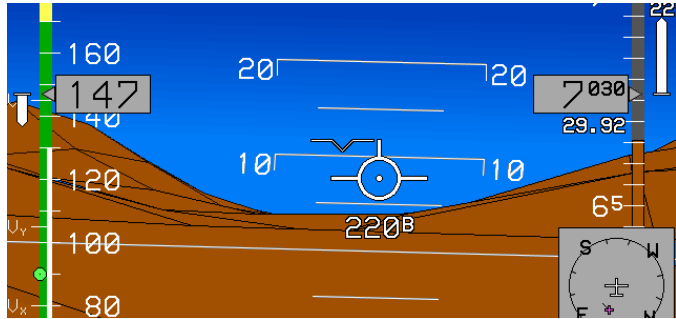
NOTE:

This is an important point; if the aircraft is descending and the active waypoint becomes obscured or partially obscured, the aircraft could impact terrain.



WARNING!

DO NOT USE THIS SYSTEM FOR TERRAIN-FOLLOWING FLIGHT. DO NOT ATTEMPT TO NAVIGATE USING THE TERRAIN DEPICTION. ALWAYS ADHERE TO PUBLISHED INSTRUMENT APPROACH PROCEDURES IN INSTRUMENT CONDITIONS.

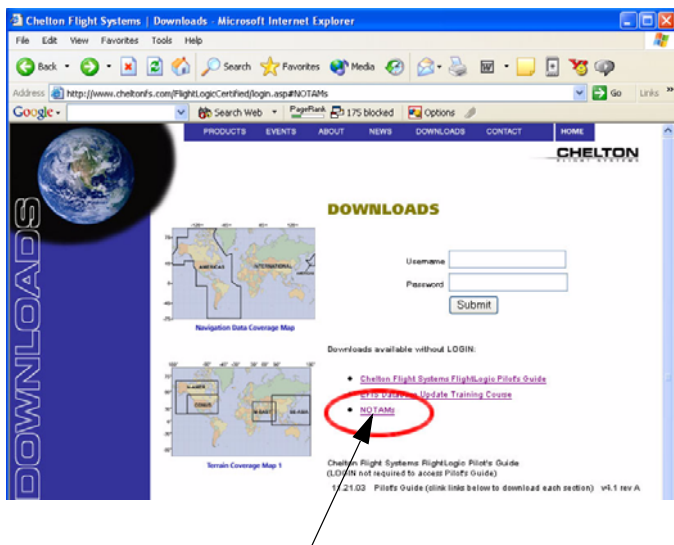


Terrain in this example is approximately 15° above the horizon on both sides of the flight path. Position of flight path marker indicates that terrain will be cleared if the current climb angle is maintained.

Terrain display is dependent on geodetic altitude, if high-quality GPS is available, otherwise, barometric altitude setting is used and, therefore, can only be as accurate as the current setting. Furthermore, while the grid uses the highest points for terrain depiction, terrain between datapoints is not displayed. This results in a “simplification” of the terrain that will be most noticeable near ground level in areas of rugged terrain.

The FlightLogic EFIS for airplanes includes integral Class C TAWS (Terrain Awareness Warning System) and, optionally, may include Class B or Class A TAWS. Helicopter systems include Class B TAWS or, optionally, Class A TAWS. For a detailed description of TAWS functions, refer to the TAWS section in the appendix.

While the Chelton EFIS uses the same terrain source as the enhanced ground proximity warning systems in airliners and is quite accurate, certain geographic areas exhibit greater errors than others.



Please see the Terrain NOTAM at www.cheltonflightsystems.com (Certified Downloads section) which is posted whenever a new terrain database is compiled. This NOTAM identifies airports in mountainous regions of the United States near which terrain database errors in excess of 100 ft. have been detected due to exceptionally rugged geography. Pilots operating near these airports should use extra vigilance.

NOTE:

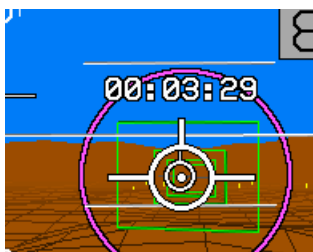
*To avoid unwanted alerts, the Terrain Awareness System must be inhibited by pushing the **TAWS INHIBIT** switch (located near the display) when approaching or departing landing site that is not included in the airport database or when a user waypoint approach has not been selected.*

***“How to use the terrain display:***

1. *Unless you want to be involved in an accident, don't use the terrain depiction in instrument conditions for operating below minimums or without regard to published procedures.*
2. *When climbing out of a valley, climb in a circle above the airport until the flight path marker is well above the terrain (be sure to account for anticipated climb deterioration).*
3. *The terrain shown on the PFD and moving map will often give you a clear understanding of why the published instrument procedures are making you do what you are doing.*
4. *If you have selected a course and altitude that will impact terrain, ignore the course and avoid the terrain visually on the PFD and moving map.*
5. *If you encounter inadvertent VFR flight into instrument conditions,*
 - a. *Remain calm and immediately set the heading bug to the reciprocal of your course.*
 - b. *Using the PFD, level the wings and ensure the flight path marker is not overlaying terrain; if it is, turn gently toward lower terrain and initiate a climb if necessary to position the flight path marker in the blue.*
 - c. *Look at the moving map to determine the direction to turn away from terrain, and turn to your heading bug.*
 - d. *If you get a terrain alert, identify the threatening terrain on the moving map and maneuver to avoid it.”*

Timer

A timer showing **hours:minutes:seconds** is displayed at the pilot's option, immediately above the flight path marker. Timer can be set to count up indefinitely or count down from a pilot-specified value. Elapsed time since take-off can also be shown without affecting an active timer. When selected, elapsed time is shown for 10 seconds in the lower right corner of the screen or until a button is pressed.

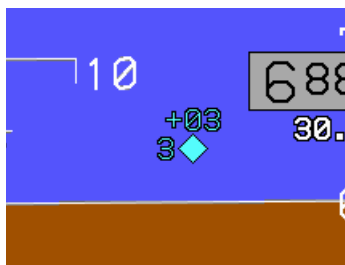


AUDIBLE ANNUNCIATION

A chime annunciates the expiration of a count-down timer.




Traffic

When interfaced with a suitable traffic receiver, airborne traffic is displayed on the PFD as symbols that are based on the level of threat. Since the artificial horizon represents ownship altitude, traffic displayed above the horizon is above your altitude, and traffic below the horizon is below your altitude.



This traffic is above your altitude (300 ft.), 3 miles away.

The relative altitude is shown above (+) the symbol when the traffic is above or below (-) the symbol when the traffic is below your altitude. Traffic distance is shown to the left of the symbol. A vertical direction arrow to the right of the symbol indicates a climb or descent greater than 500 fpm.

	Traffic Alert - Traffic within immediate vicinity based upon flight parameters.
	Proximate Advisory - Traffic within 6NM and 1,200 ft. of ownship altitude.
	Other Traffic - Traffic detected beyond 6NM and 1,200 ft.

A **Traffic Alert** will cause a “pop-up” condition on both the PFD and first MFD in a system meaning that, even if it has been manually decluttered by the pilot, traffic will automatically be shown on the displays if it represents a threat. On the moving map, the scale will be set automatically to highlight the

threatening traffic. The pilot is then free to reconfigure the displays as desired.

When the ownship AGL altitude is less than 400 ft., traffic is shown but alerts are not given. Traffic within 200 ft. of ground level is not shown or annunciated.



AUDIBLE ANNUNCIATION

Traffic alerts will result in an yellow flag and a single voice warning of “Traffic. Traffic.”

TRAFFIC

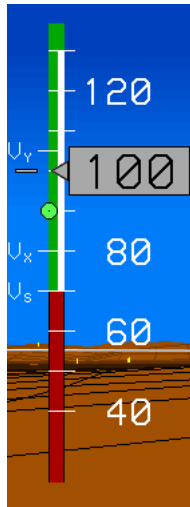
V-Speeds

Significant aircraft speeds that are not indicated by airspeed tape coloration (V_X , V_Y , V_A , etc.) are shown on the outboard side of the airspeed tape.

See **Indicated Airspeed Tape**, page 3-33 for more information.

Vs (clean stall, gross weight — the bottom of the green range) is displayed dynamically and corrected for G-force in turns and turbulence.

See **Dynamic Stall Speed**, page 3-19 for more information.



VSI

The vertical speed indicator is presented as a dynamic pointer that grows out of a fixed datum in correspondence with the vertical velocity.

The pointer grows upward from the datum in a climb and downward in a descent.

The actual vertical speed is shown digitally at the end of the pointer and is graduated in hundreds of feet per minute (example: 5 = 500 ft./min.). The digital display is rounded to the next lowest number (example: 399 ft./min. = 3) but the analog portion behaves as an analog needle. The VSI is only shown when there is a vertical velocity. Maximum VSI value is 9,999 ft./min.



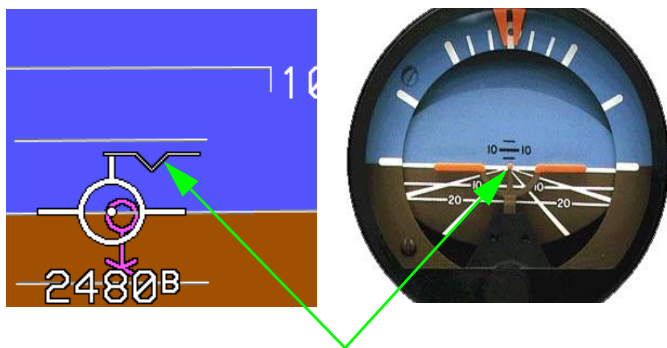
VSI showing a 300 ft./min. descent.



VSI showing a 300 ft./min. climb.

Waterline

Fixed in the center of the primary flight display, so as to align with the longitudinal axis of the aircraft, is a waterline symbol (a small “v” with wings). Rotation of the horizon and pitch scale occurs relative to the waterline symbol, indicating aircraft attitude. The waterline is analogous to the dot in the center of a mechanical attitude gyro; it is where the nose is pointed.



This is essentially the same thing although the waterline will typically indicate a few degrees up for the angle of incidence and is not adjustable.

Waypoint Direction Pointer

When the waypoint symbol is beyond the range of the directional scale, a magenta pointer indicates the shortest direction of turn to the active waypoint.



Navigation Display Symbology

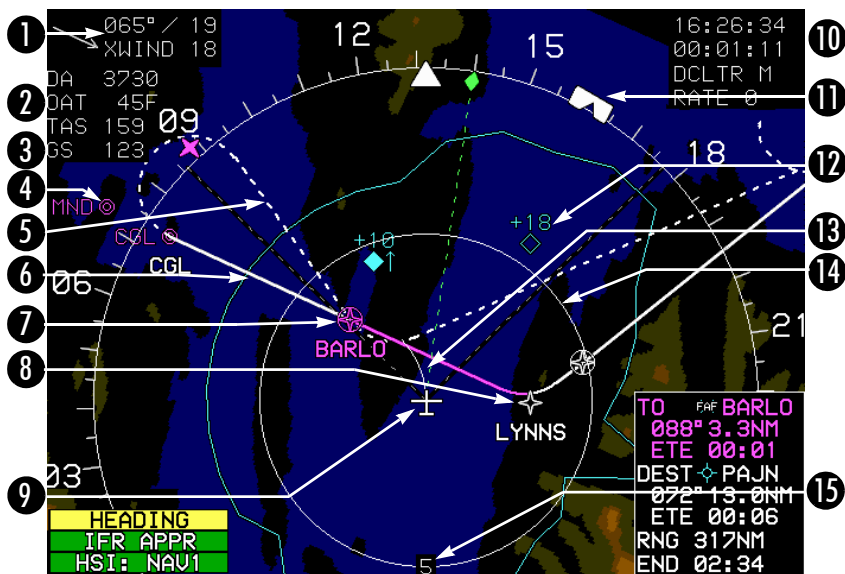
The navigation display can be presented in a variety of formats including moving map (arc or centered) in heading-up or north-up orientation, conventional HSI, dedicated traffic display, or dedicated weather display. The moving map is vector-based and uses Jeppesen NavData and other databases to display airports, navigation aids, airspace, winds, terrain, obstructions, and more. When the EFIS is integrated with the appropriate external devices, the map will display weather and traffic.

Basic Moving Map



1. Wind vector
2. Density altitude
3. True airspeed
4. Directional scale
5. Heading indicator
6. Ground track
7. Waypoint
8. Airspace
9. Courseline
10. Terrain
11. Bearing to waypoint
12. Mode annunciators
13. Ground track lubber line
14. Obstruction
15. Dead-stick glide area
16. Altitude capture predictor
17. Fuel totalizer

Moving Map with Instrument Approach



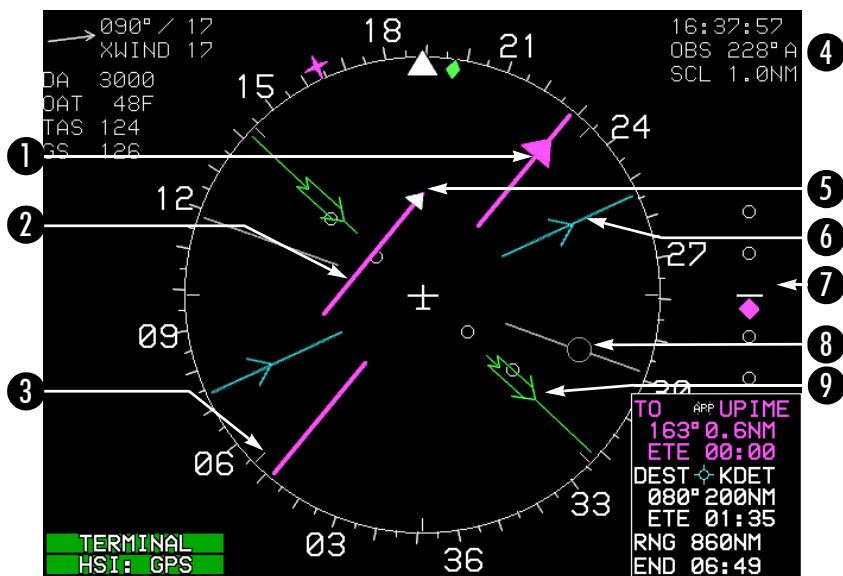
- | | |
|-------------------------------|--------------------------|
| 1. Wind data | 9. Aircraft position |
| 2. Outside air temperature | 10. Zulu clock and timer |
| 3. Groundspeed | 11. Heading bug |
| 4. NDB | 12. Traffic |
| 5. Missed approach course | 13. Projected path |
| 6. Instrument approach course | 14. Range ring |
| 7. Waypoint (fly-over) | 15. Range ring scale |
| 8. Waypoint (fly-by) | |

Moving Map with STAR



- | | |
|------------------------|---------------------------|
| 1. VFR Airport | 6. Timer |
| 2. Fix or Intersection | 7. VORTAC |
| 3. Lightning strikes | 8. Latitude longitude |
| 4. Start Waypoint | 9. Airport runway diagram |
| 5. CWA flags | 10. Navigation log |

Conventional HSI/RMI Format

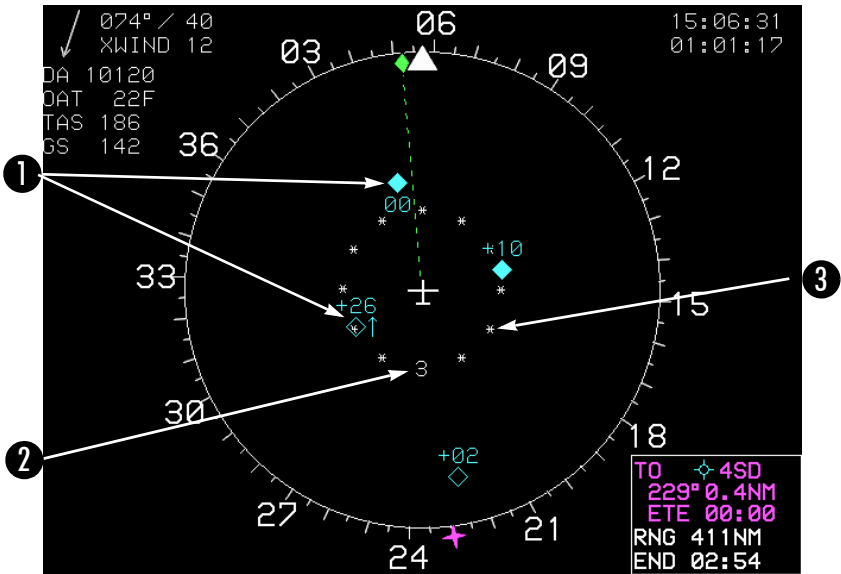


1. Courseline arrow
2. CDI needle
3. 45° marks
4. CDI scale and OBS setting
5. To-From indicator
6. RMI needle (Nav 1)
7. Glide slope indicator
8. ADF needle
9. RMI needle (Nav 2)

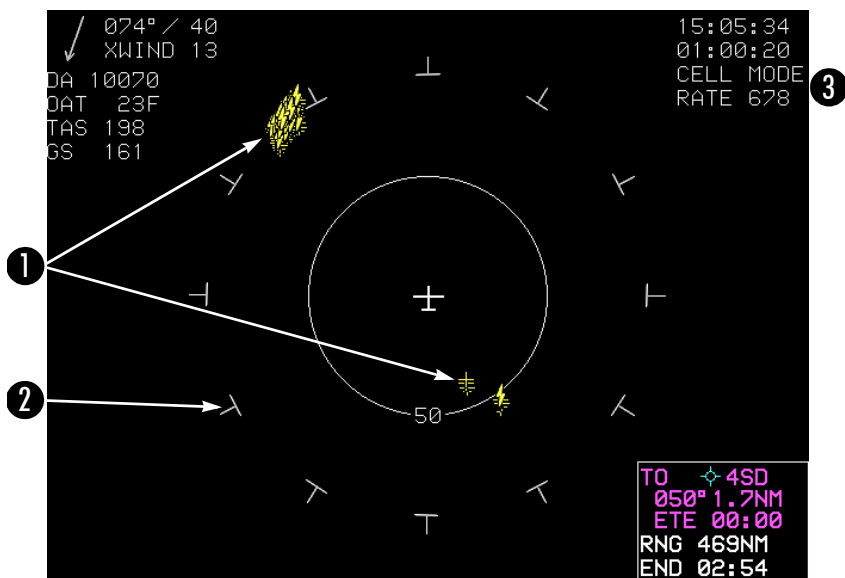
NOTE:

RMI/ADF symbolology is only available when the EFIS is interfaced with the appropriate external receivers.

Traffic Display



Lightning Display



1. Lightning strikes
2. Strike position reference
3. Mode and rate indicators

The route and waypoints may be overlaid on this display at the pilot's discretion.

NOTE:

This display page is only available when the EFIS is interfaced with a WX-500 Stormscope.

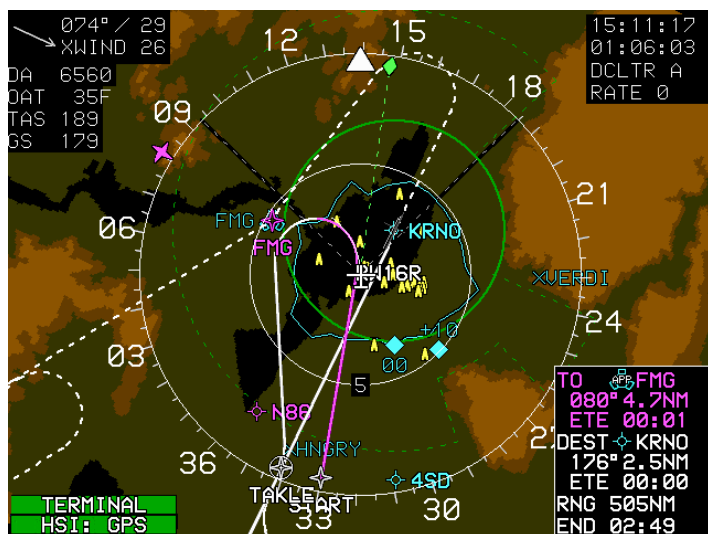
North-Up Arc Mode



North-Up Centered Mode



Heading-Up Centered Mode



Altitude Capture Predictor

When a target altitude is specified on the PFD, the point at which that altitude will be captured is shown as a green arc located ahead of the aircraft along the lubber (ground track) line, based on the current VNAV CDA settings (see **Set V-Speeds, page 5-73**). The arc marks the bottom-of-descent or top-of-climb point.



“It is important to note that this is a navigation symbol and not an aircraft performance symbol. It indicates where you WANT to capture the altitude, not where you will; your aircraft may not have the climb capability to maintain a climb at the VNAV climb angle you have set.”

Use it to plan enroute climbs and descents or meet a crossing restriction. It is perfect for complying with ATC instructions like CROSS TEN NORTH OF THE VOR AT ONE-ZERO THOUSAND when the VOR is not on your route of flight and there is no defined fix.”

Aircraft Position

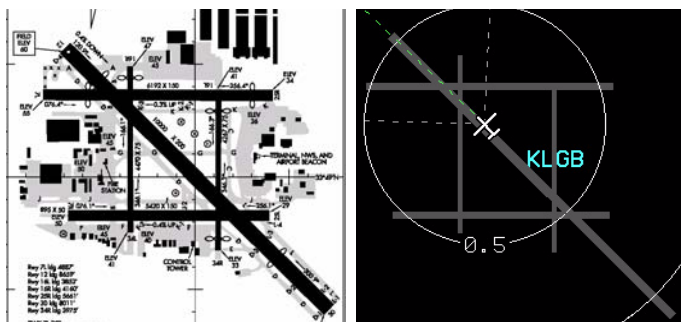
The aircraft symbol indicates ownship position relative to the map elements. The aircraft is always located at the center of the concentric range rings.



The aircraft position may be viewed in arc mode, showing approximately 240° of directional scale ahead and to the sides of the aircraft, or centered with the directional scale forming a full 360° compass rose around the aircraft.

Airport Runway Diagram

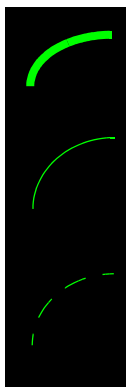
On system power up, all runways at the current airport are shown. When an approach is selected, all runways at the destination airport are shown with the usable portion of the selected landing runway displayed in a lighter shade of gray. In North-Up format, this makes a useful taxi aid that can prevent runway incursion.



Airspace Markings

Special-use and controlled airspace boundaries are indicated with lines of varying styles. Color indicates type and line style indicates relative altitude.

- Red represents **Restricted and Prohibited Areas**
- Yellow represents **MOA's and Warning Areas**
- Green represents **Class C and D** airspace
- Blue represents **Class B** airspace



Heavy, solid airspace lines indicate that the airspace will be penetrated at the current altitude.

Thin, solid airspace lines indicate that the airspace will be cleared at the current altitude, but the aircraft is **within** 500 ft. vertically of the airspace's floor or ceiling.

Thin, dashed airspace lines indicate that the airspace will be cleared at the current altitude and the aircraft is **more than** 500 ft. vertically from the airspace floor or ceiling.



“Don’t bust airspace!”

If you are VFR, crossing only thin airspace lines will keep you out of trouble. If you are IFR, airspace is irrelevant so turning it off keeps screen clutter to a minimum.”

Bearing to Waypoint

The bearing to the waypoint is indicated on the directional scale by a magenta star, which is the same symbol used for waypoints on the moving map and on the PFD directional scale.



CDI Needle / CDI Displacement Marks (HSI Format)

A CDI is centered in the middle of the conventional HSI display and shows direction and magnitude of deviation from the course when read against the courseline arrow and aircraft position symbol. The CDI needle rotates around the aircraft position symbol such that it remains parallel with the courseline arrow. The CDI needle rotates independently of the directional scale when the courseline is being set by the pilot (Manual OBS).

The HSI may be driven by Nav 1, Nav 2, or GPS and the current source is always indicated by an HSI SOURCE advisory flag.

HSI source may be changed using the OBS button (see **OBS (Omnibearing Selector) Function**, page 4-15 and **HSI Source Selection**, page 5-63).

The CDI needle moves laterally over CDI displacement marks.

During GPS/WAAS operations, the CDI scale is adjusted automatically according to phase of flight:

Enroute (more than 30NM from destination) – 2NM

Terminal (within 30NM of destination) – 1NM

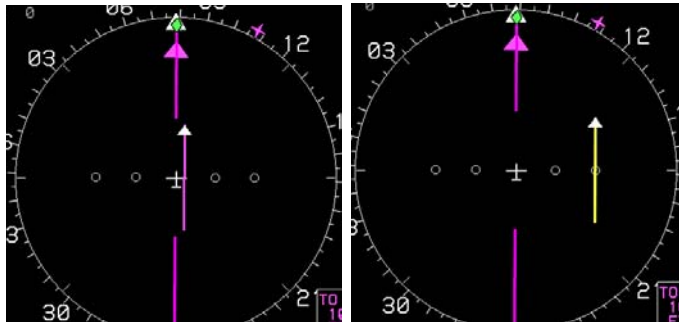
Approach (within 2NM of final approach fix) – 0.3NM

CDI Scale is measured from the center line to the second displacement mark.

In **automatic** mode, the OBS displays the course of the current route segment.

In **manual** mode, the OBS displays the pilot-entered course to the active waypoint.

Once the course is set (Manual or Automatic OBS), the CDI remains fixed relative to, and rotates with, the directional scale. The CDI displacement marks always remain perpendicular to the courseline and the CDI needle moves laterally within the limits of the scale to indicate deviation from the selected course. At full deflection, the CDI needle is displayed in yellow.

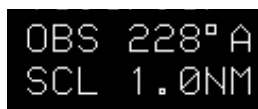


“Mind your OBS.

If your skyway or courseline doesn't seem to be working, check the OBS mode setting (Manual or Automatic is annunciated) in the upper right corner of the ND. Set the OBS using the OBS button function.”

CDI Scale and OBS Setting (HSI Format)

CDI scale value, mode, and OBS setting are annunciated in the upper right corner of the display.



OBS 228° A
SCL 1.0NM

The OBS value is followed by an “**A**” for automatic mode or an “**M**” for manual mode.

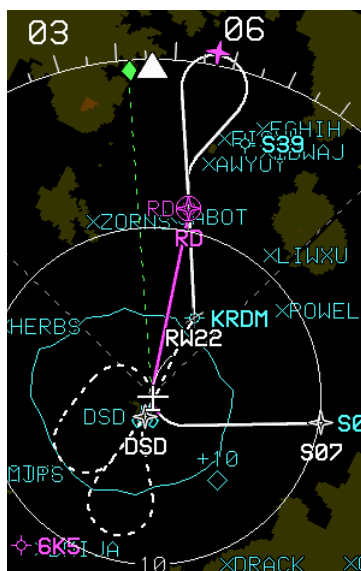
In automatic mode, the OBS displays the course of the current route segment.

In manual mode, the OBS displays the pilot-entered course to the active waypoint.

NOTE:

Only the OBS bearing is shown when HSI source is Nav 1 or Nav 2 (no scale or mode indication).

The courseline connects the waypoints of the route for both flight plans and direct navigation and is only shown when a flight plan or waypoint is activated. Turns are drawn actual size based on the speed of the aircraft or **V_{PROC}** (see page 3-45).



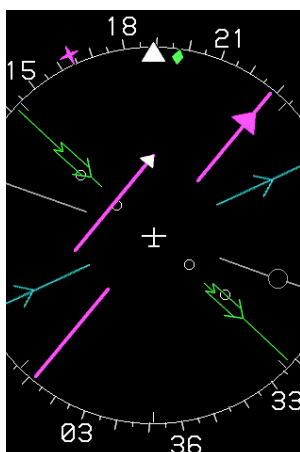
The courseline is shown in white except for the active leg, which is shown in magenta. The second waypoint is automatically activated upon selection of a flight plan. The active (magenta) leg is automatically sequenced upon waypoint passage. Any leg of the flight plan may be selected by the pilot as the active leg using the **ACTV** menu. The dotted line indicates the missed approach procedure, just like on a chart.



"If you ever lose track of the skyway, simply look at the moving map and locate the active (magenta) leg of your course. The skyway will be located along that courseline. If you still don't see it, it is probably above or below you based on target altitude."

Courseline Arrow (HSI Format)

The courseline arrow indicates the selected course (Manual or Automatic OBS) and consists of a head and tail displayed within the boundaries of the directional scale. The head and tail are always aligned with each other (allowing space for the CDI needle); the head points to the selected course and the tail points to the reciprocal of the selected course when read against the directional scale. The courseline arrow rotates independently of the directional scale when the courseline is being set by the pilot (Manual OBS or VOR OBS).



Once a course is set, the courseline arrow remains fixed relative to, and rotates with, the directional scale.

CWA Flags

The CWA (Caution/Warning/Advisory) flags alert the pilot to situations that require pilot awareness. Warnings are indicated by a red flag. Cautions are indicated by a yellow flag. Flagged advisories are indicated by a green flag.

Flags are stacked with warnings on top, followed by cautions, and then advisories. Flags are shown in reverse chronology. For a complete list of flags and annunciations, as well as order of prioritization, see **Caution/Warning/Advisory System, page 2-12**.



AUDIBLE ANNUNCIATION

CWA flags are accompanied by an auditory annunciation.

Dead-Stick Glide Area

The area in which a power-off landing can be made from the current altitude is shown as an irregular light blue line encircling the aircraft position symbol. This is a dynamic calculation and changes constantly during flight.



The glide area, as presented, is based on the aircraft's best-glide speed (the green dot on the airspeed tape). The glide area is

adjusted for turns, wind, terrain, airspeed, pilot reaction time, and stored energy, and indicates the point at which the aircraft will be at approximately 200 feet above the ground during the glide.

Density Altitude

The density altitude display corrects pressure altitude for nonstandard temperatures. Measurement is in feet MSL.(mean sea level)



Density altitude is shown in yellow any time conditions are above standard day.

Directional Scale

A stabilized directional scale is presented as the outermost range ring on the navigation display. Directional scale may be viewed in an arc or centered format.



Directional scale in arc



Directional scale in centered format

Fix

Airway fixes or intersections are depicted as a cyan **X** with cyan labels.



Fuel Totalizer

Fuel range (**RNG**) and endurance (**END**), based on fuel totalizer calculations, are displayed in nautical miles and hours:minutes respectively. Totalizer information is displayed at the bottom of the waypoint navigation log for quick comparison with flight plan information.



AUDIBLE ANNUNCIATION

A fuel range less than the distance (along the route) to the destination plus 100 miles will result in an annunciation chime and an yellow “CHECK RANGE” flag. To eliminate nuisance alarms, range checking is suppressed when on the ground or in a climb.

CHECK RANGE

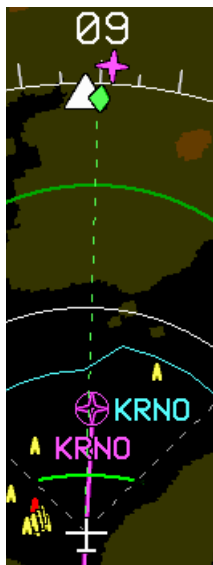
Groundspeed

The aircraft’s speed over the ground, in nautical miles per hour is displayed in the upper left corner below the true airspeed. Groundspeed is based on GPS data.



Ground Track / Ground Track Lubber Line

The aircraft's straight-and-level track over the ground is indicated on the directional scale by a green diamond. Ground track is based on GPS signal. The ground track symbol is connected to the aircraft symbol by a dashed green "lubber" line.



"The lubber line is handy.

Use it to ensure your current ground track will clear terrain or airspace. Also, you can use it to cross a specific fix or waypoint that is not in your active flight plan."

Heading Bug

The heading bug is a white “bow tie” symbol affixed to the directional scale. The heading bug is only visible when activated.



NOTE:

*If coupled with an autopilot placed in **HEADING** mode, the EFIS will command the autopilot to maintain the selected heading. If the autopilot is flying a flight plan, **invoking the heading bug will override the flight plan** in favor of the selected heading. When the heading bug is turned off, the EFIS will command the autopilot to rejoin the active flight plan.*

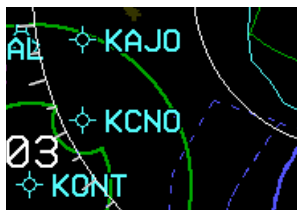
Heading Pointer

The heading pointer is a white triangle indicating the current aircraft heading (where the nose is pointed).



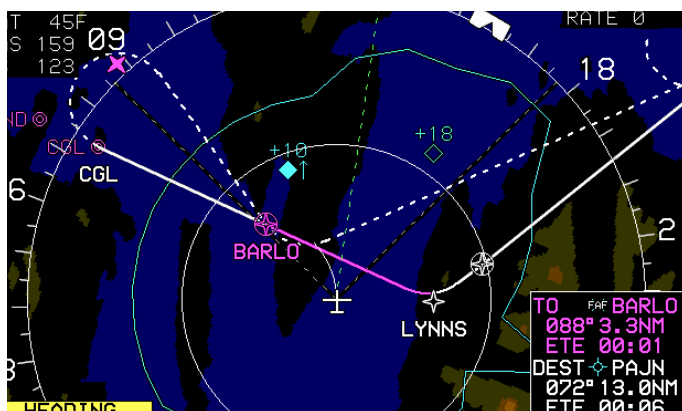
IFR Airport

IFR airports are depicted as a blue circle with a pronounced tick mark every 90°. IFR airports have published IFR approaches.



Instrument Approach Course

Instrument approach procedures are depicted as white courselines except the active leg, which displayed in magenta. Active legs of an approach are automatically sequenced. Alternately, the pilot can select any leg as the active leg by using the **ACTV** button function. The missed approach course is depicted as a dashed white line with the active leg displayed in magenta.



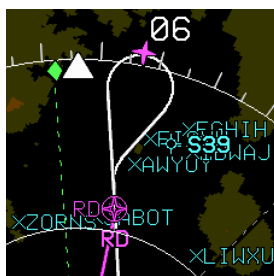
Approach symbolology includes approach fixes (both fly-over and fly-by), procedure turns, missed approaches, holding patterns, and holding pattern entries.



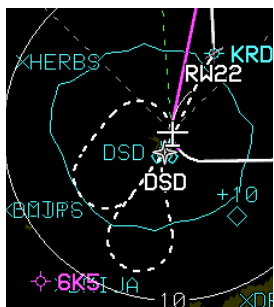
BARLO is an example of a fly-over fix. They have a circle around the waypoint star symbol.



LYNNS is an example of a fly-by fix. They are a waypoint star symbol without a circle.



Procedure turn at fix RD (an NDB).



Entry to missed approach holding pattern at DSD (here, the aircraft has left the holding pattern and is flying the approach again from DSD).

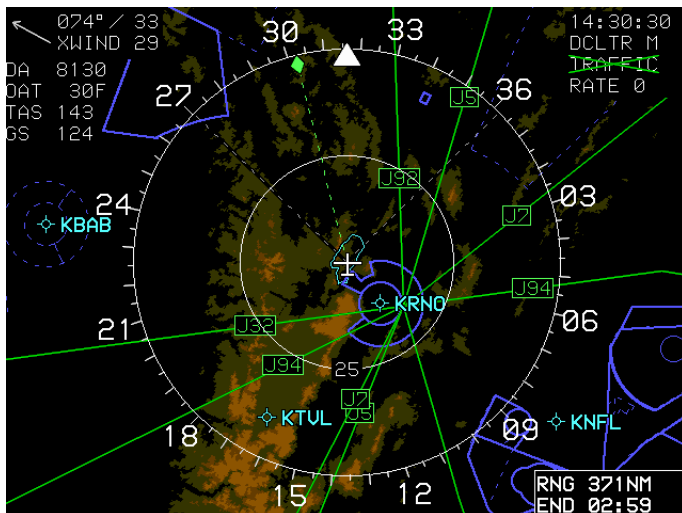
See Waypoint Sequencing, page 120, for information on waypoints and waypoint sequencing.

NOTE:

See *Jeppesen NavData Chart Compatibility* in the Appendix for information on approach waypoint nomenclature.

Jet Routes

Jet routes, or high-altitude airways, are shown in green, along with their labels. To minimize clutter, jet routes are not shown by default; they may be shown at any time by the pilot using the **MENU** . . then **FORMAT** . . then **DCLTR** . . then **NAV SYMB** . . menu.

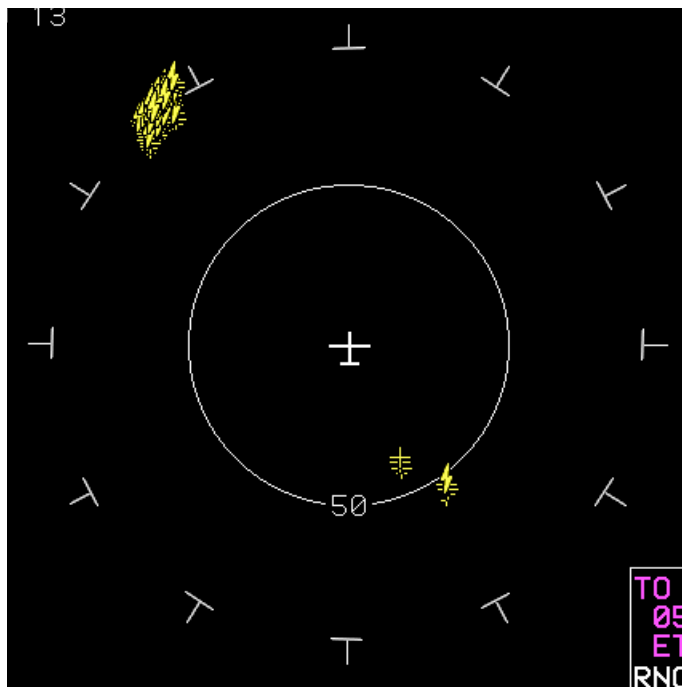


NOTE:

Jet route labels only show the first label. Refer to printed charts for routes that have more than one label.

Lightning Strikes

Lightning strikes from an attached WX-500 Stormscope are initially displayed as yellow lightning bolts. After 20 seconds, the lightning bolt changes to a large yellow + sign. After two minutes, it is reduced to a small yellow + sign. After three minutes, the symbol is removed from the display.



Lightning strikes may be shown on the moving map or on a dedicated Lightning display screen (with or without route overlay).

Lightning may be displayed in one of two modes: cell mode or strike mode. Strike mode shows every strike detected. In cell mode, the WX-500 filters the strike data to display storm cells. The moving map only shows cell mode.

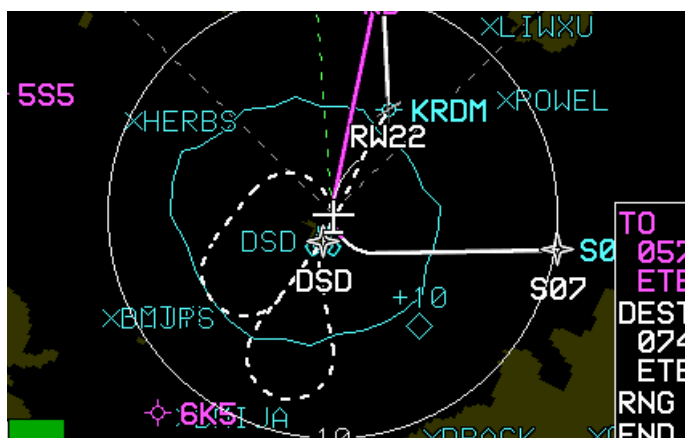
A new strike rate value, based upon the strikes within the selected range, will be calculated every 5 seconds during

normal operation. The number of fresh strikes (strikes less than 20 seconds old) is used to generate a strike rate that represents strikes per minute. Strike rate increases are shown immediately upon calculation while decreases in strike rate are dampened.

Activating the Clear Strikes function resets the strike rate to zero.

Missed Approach Course

The missed approach course is shown as a dashed white line beginning at the missed approach point, with the active leg being shown in magenta. See **Waypoint Sequencing, page 3-120**, for information on waypoints and waypoint sequencing during missed approach procedures.



Mode Annunciators

Omnibearing Selector Mode (OBS)

Selected omnibearing radial is shown in magenta along with the current mode (**M** for Manual or **A** for Automatic). Automatic mode simply displays the active flight plan segment course while manual mode allows the pilot to specify a radial or to the active waypoint.

Terrain Mode - Map only

If terrain is OFF, an annunciator in the upper right corner will read **TERRAIN** with an **X** through it. The **X** will be green if the pilot manually turns terrain off and red if terrain is disabled automatically due to a sensor failure. See example below.

Terrain mode is always the same for both the PFD and moving map screens on the MFD. For example, turning terrain OFF on the moving map turns it OFF on the reversionary PFD simultaneously. However, terrain mode is not transmitted between displays, so it is possible to run one screen with terrain and another without.

Manually turning the terrain off does not affect TAWS alerting functions. See the TAWS section of the appendix for more information.

Declutter Mode (DCLTR) - Map only

The current declutter (**M** for Manual or **A** for Automatic) is annunciated in white in the upper right corner of the display.

Traffic Mode - Map and Traffic display only

If equipped with a Ryan TCAD receiver, an annunciator in the upper right corner will read **TRAFFIC** with an **X** through it when it is disabled. The **X** will be green if the pilot manually turns traffic display off and red if it is disabled automatically due to a sensor failure. See example below.

Manually turning the traffic off does not affect traffic alerting functions.

Lightning mode (STRKS) - Map and WX display only

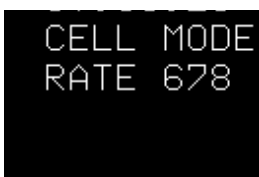
If equipped with a Goodrich WX-500 Stormscope, an annunciator in the upper right corner will read **STRIKES** with an **X** through it when it is disabled. The **X** will be green if the pilot manually turns traffic display off and red if it is disabled automatically due to a sensor failure.

**Dedicated Lightning Display**

If equipped with Goodrich WX-500 Stormscope, the display mode (**CELL** or **STRK**) and strike rate will be displayed in the upper right corner of the dedicated lightning display. Strike mode shows every strike detected. In cell mode, the WX-500 filters the strike data to display storm cells.

A new strike rate value, based upon the strikes within the selected range, will be calculated every 5 seconds during normal operation. The number of fresh strikes (strikes less than 20 seconds old) is used to generate a strike rate that represents strikes per minute. Strike rate increases shown immediately upon calculation while decreases in strike rate are dampened.

Activating the Clear Strikes function resets the strike rate to zero.



Navigation Log

Waypoint navigation information is displayed in the navigation log box located in the lower right corner of the display. The navigation log is only displayed when there is an active waypoint.



The navigation log shows the range, bearing, and estimated time enroute to the active “**TO**” waypoint and the destination “**DEST**” waypoint (along the route). Only the “**TO**” waypoint is shown if the “**TO**” and “**DEST**” waypoints are the same.

Fuel totalizer (range and endurance) is shown immediately below the navigation log for easy comparison.

NDB

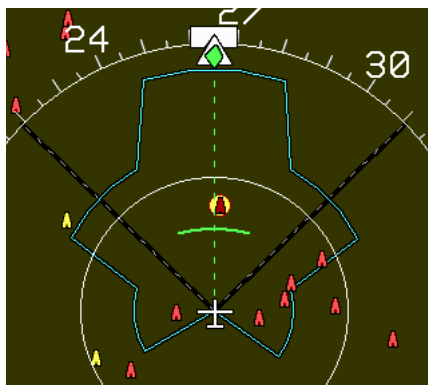
NDBs are depicted as two small, concentric magenta circles with the identifier adjacent.



Obstruction

Antennas, towers, and obstructions are displayed only in conjunction with the terrain. Obstruction symbols Δ are depicted using color to show relationship to aircraft altitude as follows:

1. Obstructions beyond 6NM in any cardinal direction are not depicted.
2. Obstructions whose tops are lower than 2,000 feet below aircraft altitude are not depicted.
3. Obstructions whose tops are within 2,000 feet but more than 500 feet below aircraft altitude are depicted in yellow.
4. Obstructions whose tops are within 500 feet but below aircraft altitude are depicted in light red.
5. Obstructions whose tops are at or above aircraft altitude are depicted in bright red.



Obstructions are included in the TAWS search envelopes and will generate a caution or alarm if they represent a collision hazard. Obstructions generating a caution are highlighted. Obstructions generating a warning are highlighted and flashing. In areas with many obstructions, this enables easy identification of those causing the alerts.

Outside Air Temperature

Outside air temperature (**OAT**) is displayed in the upper-left corner of the navigation display, between density altitude (**DA**) and true airspeed (**TAS**). OAT is measured in °F or °C, depending on system installation settings.



Projected Path

The curving white line extending from the nose of the aircraft symbol indicates the horizontal flight path of the aircraft projected one minute into the future or 180°, whichever comes first. The projected path is corrected for bank angle and groundspeed and is only displayed when the aircraft is in a turn.



“No-sweat course interception.

Use the projected path to intercept courses perfectly from any angle. Roll in an estimated bank angle and see where that puts your projected path. Make small bank adjustments as necessary to keep the projected path tangent to the desired courseline. Roll out centered on course. If interception will require an uncomfortable bank angle, you'll know you have to overshoot and come back in from the other side. It's great for when ATC gives you a late turn onto the localizer.”

Range Ring

The range ring is a white circle (centered on the aircraft's position) used to quickly estimate distances. Distance (in nautical miles) from the aircraft to the ring is shown as a white figure overlaying the six o'clock position of the ring. The range ring is half the distance to the directional scale. Consequently, when the range ring shows a distance of 5NM, the directional scale is at 10NM. Overall map scale ranges can be set to 1, 2, 5, 10, 20, 50, 100, 200, and 400 nautical miles.



Range Ring Scale

Distance (in nautical miles) from the aircraft to the ring is shown as a white figure overlaying the six o'clock position of the ring. The intermediate range ring is half the distance to the outer range ring. So, when the intermediate range ring shows a distance of 5NM, the outer ring is at 10NM.



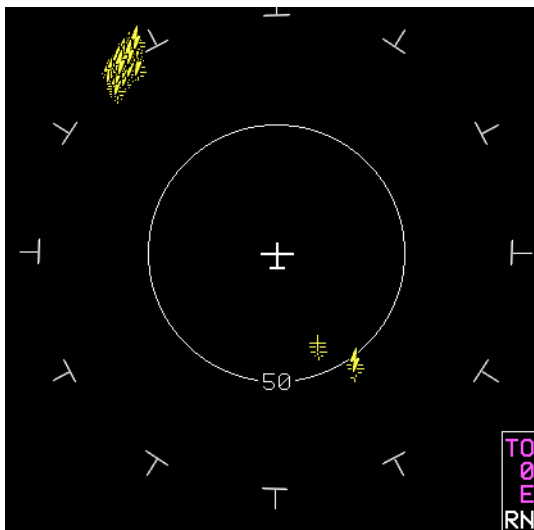
Start Point

Activation of the **NRST** or **Direct-To** functions creates and activates a flight plan from the current aircraft position to the selected waypoint. A waypoint named **START** is placed at the current aircraft location when the flight plan is created.



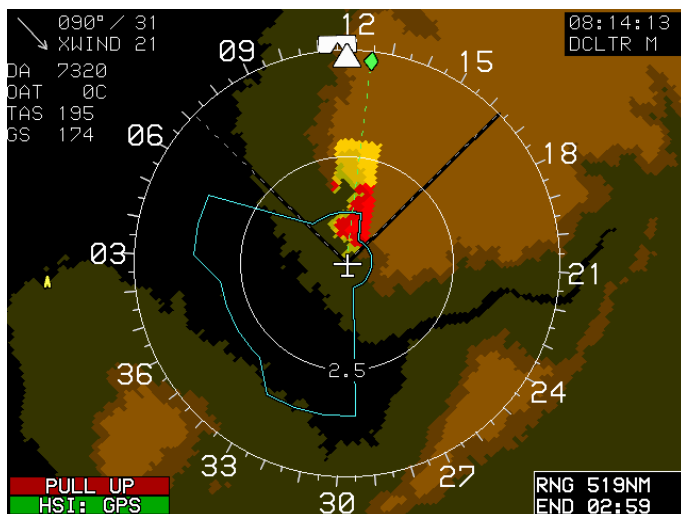
Strike Position Reference (Dedicated Lightning Display)

T-shaped tick marks are shown around the perimeter of the dedicated lightning display corresponding to positions of the clock to aid in avoiding and reporting strikes relative to aircraft position.



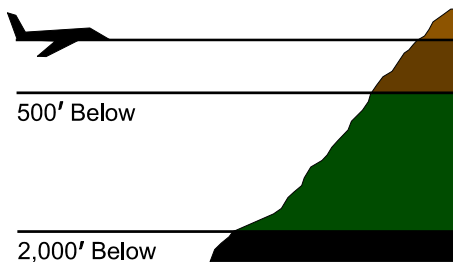
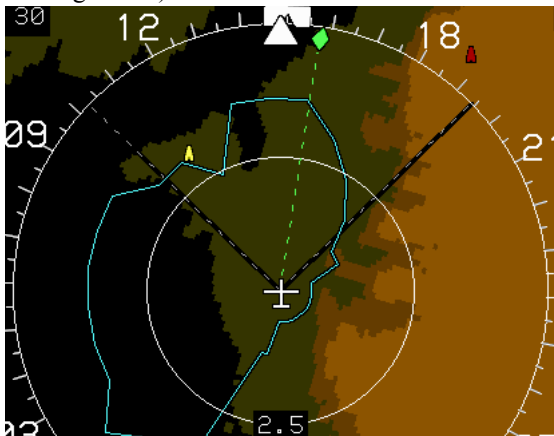
Terrain

Terrain is displayed around the aircraft and is color-coded as **threatening** and **non-threatening** terrain.



Non-Threatening Terrain

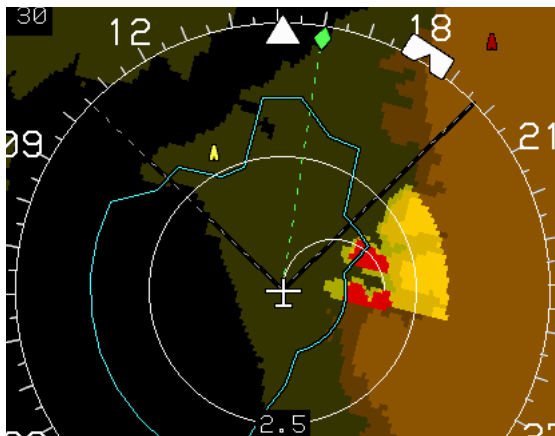
Terrain areas are colored black when more than 2,000 feet below aircraft altitude; dark olive when within 2,000 feet but more than 500 feet below aircraft altitude; dark brown when within 500 feet but below aircraft altitude; and light brown when at or above aircraft altitude. Deep blue denotes areas of water and takes precedence over other colors (except TAWS alerting colors).



Non-threatening terrain coloration.

Threatening Terrain

Threatening terrain, as determined by the requirements for TAWS, is colored in red and yellow. The red and yellow colors are shown with a “transparency” that allows the underlying contours to be distinguished to aid a terrain avoidance maneuver.



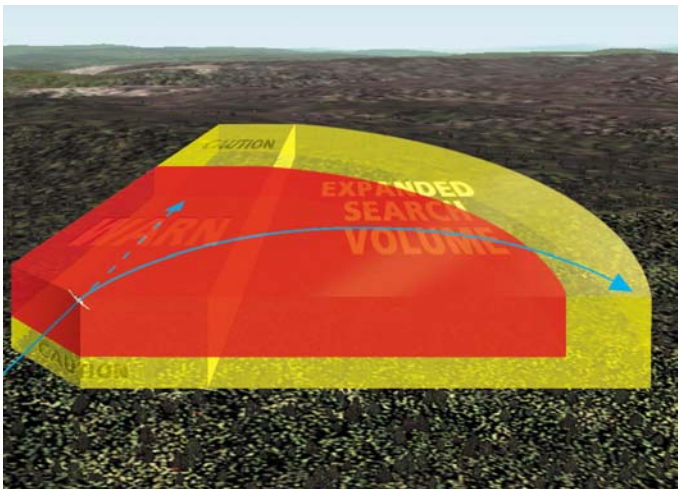
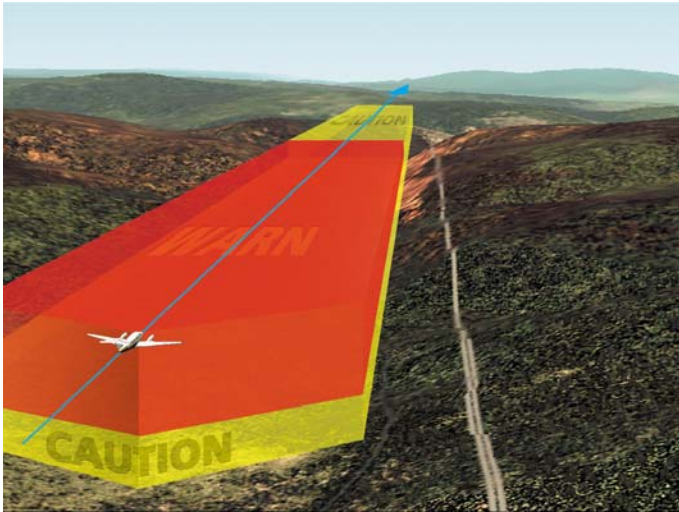
Threatening terrain will cause a “pop-up” condition on both the PFD and first MFD in a system meaning, even if it has been manually decluttered by the pilot, terrain will automatically be shown on the displays. On the moving map, the scale will be set automatically to highlight the threatening terrain. The pilot is then free to reconfigure the displays as desired.

TAWS

The FlightLogic EFIS features integrated Class C TAWS or, optionally, Class A or B TAWS or Class A or B Helicopter TAWS (HTAWS).

Class B and C TAWS provide the following terrain alerting functions:

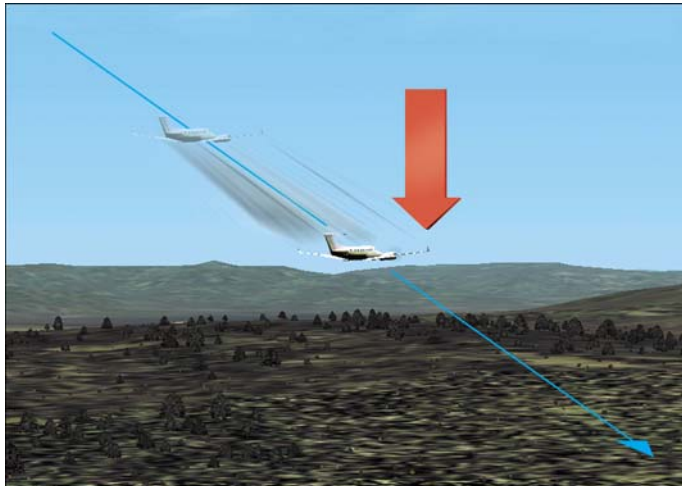
1. Forward Looking Terrain Awareness (“FLTA”): A warning function that uses a terrain database to alert the pilot to hazardous terrain in front of the aircraft, automatically adjusting for climbs, descents, and turns (see preceding graphic).



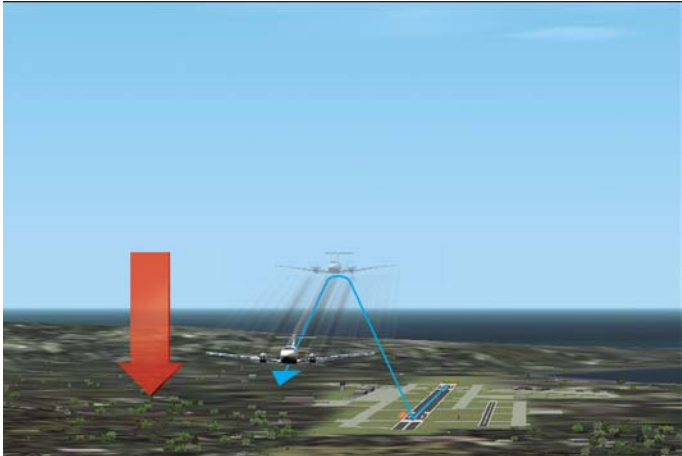
2. Premature Descent Alert (“PDA”): A warning function that alerts the pilot when descending well below a normal approach glide path on the final approach segment of an instrument approach procedure.



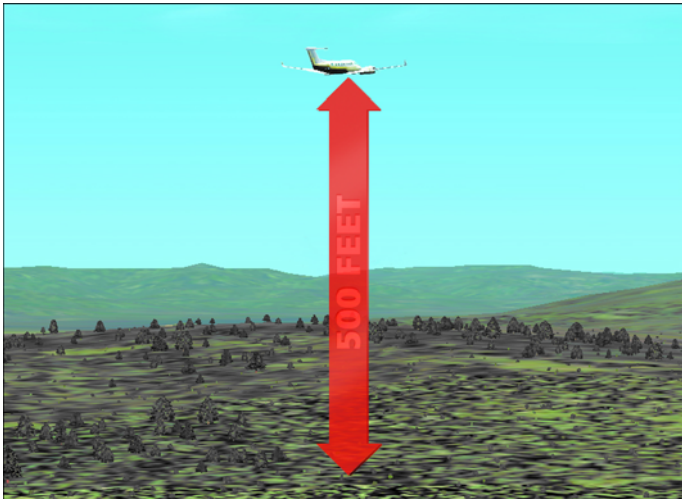
3. Excessive Rate of Descent: A warning function that alerts the pilot when the rate of descent is hazardously high as compared to height above terrain (i.e., descending into terrain).



4. Sink Rate after Takeoff or Missed Approach: A warning function that alerts the pilot when a sink rate is detected immediately after takeoff or during initiation of a missed approach.

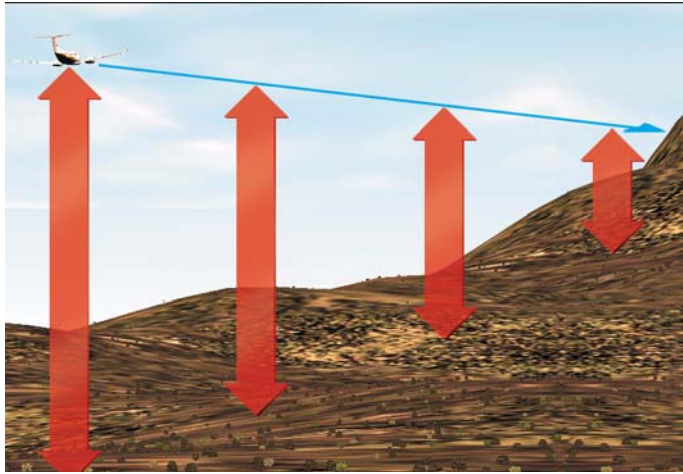


5. 500 foot Wake-up Call: A single voice callout when descending through 500 feet AGL.

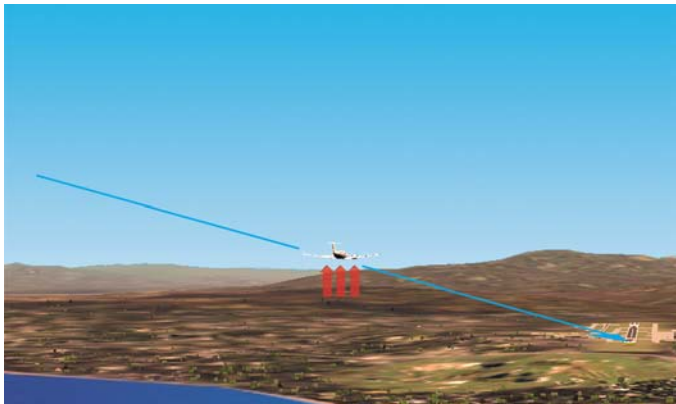


Class A TAWS incorporates gear and flap position, radar altitude, and ILS signal and adds the following functions:

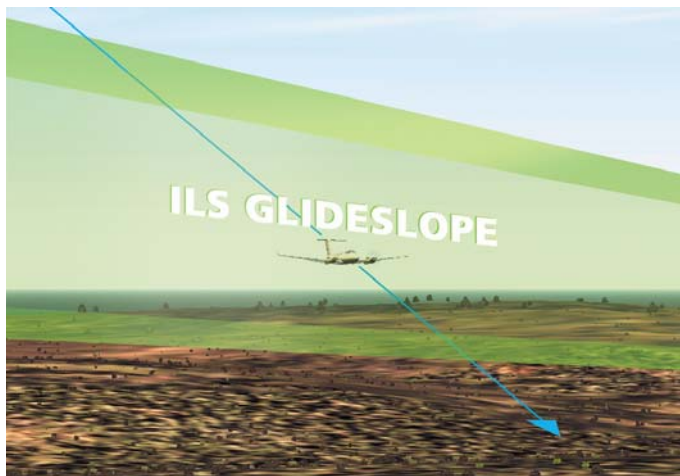
1. **Excessive Closure Rate to Terrain:** This function uses AGL rate of change and AGL altitude to alert the pilot when the rate of change of height above terrain is hazardously high as compared to height above terrain (i.e., flying level over rising terrain).



2. **Flight into Terrain when not in Landing Configuration:** This function uses aircraft speed and AGL altitude to alert the pilot when descending into terrain without properly configuring the aircraft for landing.



3. Excessive Downward Deviation from an ILS Glideslope: This function uses ILS glideslope deviation information and AGL altitude to alert the pilot when an excessive downward glideslope deviation is detected on the final approach segment of an ILS approach.



Each of the above TAWS conditions is accompanied by a voice annunciation and, except for the 500 foot callout, a CWA flag color-coded yellow for caution and red for warning.

HTAWS features all of the above but the terrain clearance requirements are reduced for lower normal operation.

In helicopters A LOW ALTITUDE switch near the PFD further reduces the clearance requirements to minimize nuisance alerts during low-altitude operations.

A TAWS INHIBIT switch near the PFD mutes the voice warning and removes the caution and warning flags but the terrain is still colored for caution and warning conditions.

See **Caution/Warning/Advisory System**, page 2-12 of System Overview section for details of the auditory annunciations associated with terrain.



“The bottom line on terrain and TAWS:

If you see red or yellow on the moving map, accompanied by a voice alert, take action immediately. Use extreme caution and be suspect of yellow terrain. Add power, climb, and turn away from red terrain. You have two very effective terrain displays, the moving map and primary flight display; use them both to your advantage.”

For detailed information on the TAWS class in your aircraft, see the TAWS section in the appendix.

Timer

A timer showing **hours:minutes:seconds** is displayed at the pilot's option in the upper right corner of the display, just below the clock. The timer can be set to count up indefinitely or count down from a pilot-specified value. Elapsed time since take-off can also be shown without affecting an active timer. When selected, elapsed time is shown for 10 seconds in the lower right corner of the screen or until a button is pressed.

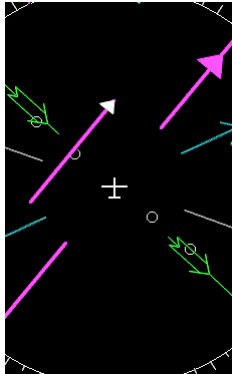


AUDIBLE ANNUNCIATION

A chime annunciates the expiration of a count-down timer.

To-From Indicator (HSI Format)

The to-from indicator is a white triangle placed at the end of the CDI needle on the conventional HSI display, between the aircraft position symbol and the courseline arrow. The arrow is ahead of the aircraft symbol and points toward the courseline arrowhead when showing a “to” indication and behind the aircraft symbol and pointing toward the tail of the courseline arrow when showing a “from” indication.



Once a course is selected (Automatic or Manual), the to-from indicator rotates with the directional scale. The indicator will flip from one end of the CDI needle to the other upon waypoint or navigation station passage.

The HSI may be driven by Nav 1, Nav 2, or GPS and the current source is always indicated by an HSI SOURCE advisory flag.




HSI source may be changed using the OBS button, see **OBS (Omnibearing Selector) Function, page 4-15** and **HSI Source Selection, page 5-63**.

Traffic

When interfaced with a suitable traffic sensor, airborne traffic is displayed on the moving map as symbols that are based on the level of threat.



The relative altitude is shown above (+) the symbol when the traffic is above or below (-) the symbol when the traffic is below ownship altitude. A direction arrow to the right of the symbol indicates a climb or descent greater than 500 fpm.

	Traffic Alert - Traffic within immediate vicinity based upon flight parameters.
	Proximate Advisory - Traffic within 6NM and 1,200 ft. of ownship altitude.
	Other Traffic - Traffic detected beyond 6NM and 1,200 ft.

A **Traffic Alert** will cause a “pop-up” condition on both the PFD and first MFD in a system meaning that, even if it has been manually decluttered by the pilot, traffic will automatically be shown on the displays if it represents a threat. On the moving map, the scale will be set automatically to highlight the

threatening traffic. The pilot is then free to reconfigure the displays as desired.

When the ownship AGL indication is less than 400 ft., traffic is shown but alerts are not given. Traffic within 200 ft. of ground level is not shown or annunciated.

***AUDIBLE ANNUNCIATION***

Traffic advisories will result in an yellow flag and a voice warning of “Traffic. Traffic.”

TRAFFIC

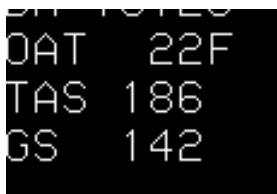
Traffic Position Reference (Dedicated Traffic Display)

Asterisks are shown around the ownship aircraft symbol on the dedicated traffic display corresponding to positions of the clock to aid in identifying traffic relative to aircraft position. The scale of the reference ring is shown at the six o'clock position.



True Airspeed

True airspeed, (**TAS**) airspeed is displayed in the upper left corner of the display, between outside air temperature (**OAT**) and groundspeed (**GS**). True airspeed is measured in knots and is corrected for altitude, temperature, and compressibility due to aerodynamic heating.



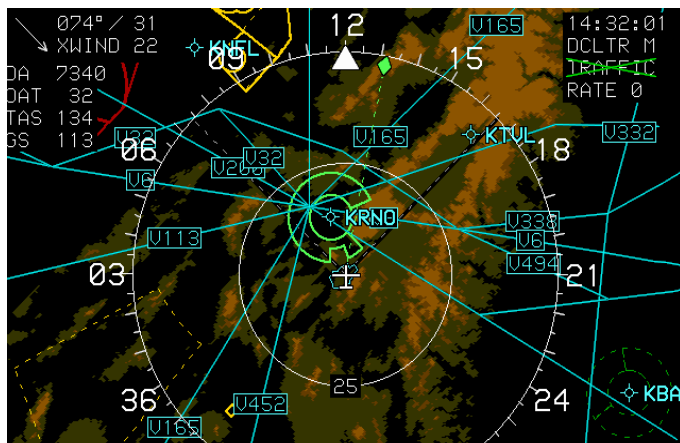
VFR Airport

VFR airports (airports having no published instrument procedures) are displayed in magenta, along with the identifier.



Victor Airways

Victor, or low-altitude airways are displayed as cyan lines along with their identifiers. To minimize clutter, Victor airways are not shown by default; they may be shown at the pilot's discretion using **MENU** button, then **FORMAT ..** then **DCLTR ..** then the **NAV SYMB ..** menu.



NOTE:

Victor airway labels only show the first label. Refer to printed charts for airways that have more than one label.

VORTAC/VOR-DME, TACAN, VOR, DME

VHF nav aids are displayed in cyan with the following symbols:



Waypoint

Route waypoints are displayed as four-point stars. The active waypoint is displayed in magenta; prior and subsequent waypoints in the route are white. Fly-over waypoints are enclosed in a circle, while fly-by waypoints are not.

The identifier associated with each waypoint is shown below the star in the same color.



BARLO is an example of a fly-over waypoint.



LYNNS is an example of a fly-by waypoint.

Waypoint Sequencing

The system defines the desired flight path based upon the active flight plan. The active flight plan can be recalled from a list of stored flight plans or generated using the Nearest function

(NRST) or **Direct-To** function, then adding and deleting waypoints en route.

In most cases, the system will auto-sequence from one waypoint to the next, in accordance with the flight plan. Waypoint auto-sequencing will be suspended in the following cases:

1. A manual GPS/WAAS OBS is set (“SUSPEND” flag shown).
2. The aircraft is on the final approach segment of an instrument approach and the missed approach procedure has not been armed by pressing the **MISSED** button (“SUSPEND” flag shown).
3. The aircraft is in a published holding pattern and the pilot has not chosen to continue out of the holding pattern by pressing **CONTINUE** (“SUSPEND” flag shown).
4. The active waypoint is the last waypoint of the active flight plan (“SUSPEND” flag not shown).

Where automatic waypoint sequencing is suspended due to manual GPS/WAAS OBS, being on the final approach segment without arming the missed approach procedure, or being on the last leg of the active flight plan, the system automatically switch from TO operation to FROM operation when appropriate. When an IFR approach is selected and the next waypoint is the missed approach point, automatic waypoint sequencing is suspended. Automatic waypoint sequencing is also suspended when the active waypoint is a holding point or when the pilot has selected Manual OBS mode.

**AUDIBLE ANNUNCIATION**

Suspension of automatic waypoint sequencing is annunciated by an auditory chime and an advisory SUSPEND flag.

SUSPEND

Discontinuity

Where the system is unable to construct a smooth, continuous flight path due to active flight plan waypoint spacing (i.e., spacing too close for turn radius), a discontinuity will be placed between the waypoints. This is indicated in the ACTV menu by **-DISCONT-** between the waypoints.

When a discontinuity exists, no path or skyway is drawn between the waypoints and auto-sequencing past the waypoint leading into the discontinuity shall will not occur. It is not be possible to activate the phantom waypoint after the discontinuity as it is not possible to provide path guidance to this waypoint. Attempting to activate the phantom waypoint after the discontinuity will result in activation of the next waypoint or, if there is no next waypoint (i.e., end of active flight plan) activation of the waypoint leading into the discontinuity.

In addition to the above, selecting a vectors-to-final IFR approach, a VFR approach, or re-centering on your route using **Direct-To** will result in a discontinuity.

Wind Data

Wind data is presented in the upper-left corner of the Navigation Display. Wind velocity (measured in knots) and direction are displayed based on GPS, heading, and airdata calculations.



During normal system operation, wind is calculated during periods of relatively wings-level flight (bank < 6°). The wind calculation considers TAS, heading, GS and track. Factors that affect these parameters can cause inaccuracies in the calculated wind. The pilot should be cognizant of the following potential error sources:

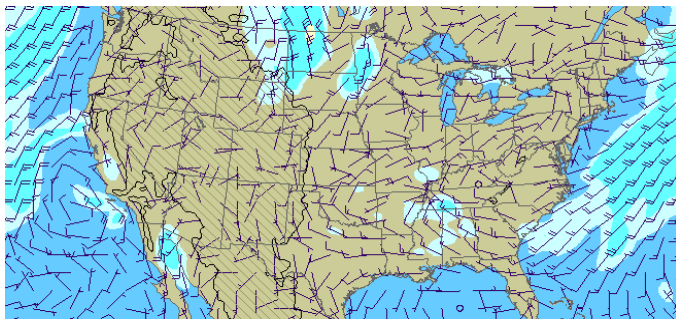
TAS: True airspeed errors can be caused by airframe induced pitot-static inaccuracies, pitot-static system leaks or blockages, and inaccurate outside air temperature readings.

Heading: Heading errors can be caused by poor AHRS alignment, carrying iron-bearing materials in proximity to the AHRS, and operation of electric motors or other magnetic field inducing equipment. In addition, for the wind calculation to be accurate, heading must match the vector direction of TAS. As a rule of thumb, if the aircraft is being flown out of coordination, the wind calculation should be considered suspect.

Groundspeed: Poor satellite geometry can cause variations in the ground speed reading. Although this parameter is generally reliable, it should be considered suspect when a GPS “Loss of Integrity” exists.

Track: Poor satellite geometry can cause variations in the track reading. Although this parameter is generally reliable, it should be considered suspect when a GPS “Loss of Integrity” exists.

Atmospheric wind changes: As seen in this FAA graphic, actual wind is rarely constant and the direction and velocity can change in a few minutes.



The pilot should expect large wind changes with changes in altitude or in the presence of significant weather. The pilot should also consider the effect of surrounding terrain upon wind.

Wind Vector

The wind vector is a graphical depiction of current winds aloft displayed relative to aircraft symbol regardless of map display mode (see **Wind Data** illustration above).

NOTE:

*See discussion of wind calculation errors under **Wind Data** above.*

Zulu Time

Current Zulu time, based on GPS clock, is displayed in the upper-right corner of display.

07:53:54

CWA Flags

The CWA (**Caution/Warning/Advisory**) flags alert the pilot to situations that require pilot awareness. Warnings are indicated by a red flag. Cautions are indicated by a yellow flag. Flagged advisories are indicated by a green flag.

Flags are stacked with warnings on top, followed by cautions, and then advisories. Flags are shown in reverse chronology. For a complete list of flags and annunciations, as well as order of prioritization, see **Caution/Warning/Advisory System, page 2-12**.

Failure Modes



AUDIBLE ANNUNCIATION

CWA flags are accompanied by an auditory annunciation.

Failure of a weather receiver, datalink receiver, TCAS/TCAD receiver, or AIU-1 results in the EFIS issuing an yellow caution flag and auditory chime. None of these receivers or devices significantly impact the navigational or display capabilities of the EFIS.

Failure of the GPS, the AHRS or the ADC, singly or in combination, adversely impacts the EFIS capabilities. These failures are annunciated with yellow caution flags on the MFD and corresponding voice warnings. In addition, the software provides degraded displays to show as much useful and accurate information as possible in the failure condition. These degraded displays are described in detail as follows.

The equipment has 8 operating modes depending upon the status of the attached sensors. The modes are:

Mode 0: GPS, ADC, and AHRS normal.

Mode 1: GPS failed, ADC and AHRS normal.

Mode 2: ADC failed, GPS and AHRS normal.

Mode 3: AHRS failed, GPS and ADC normal.

Mode 4: GPS and ADC failed, AHRS normal.

Mode 5: GPS and AHRS failed, ADC normal.

Mode 6: ADC and AHRS failed, GPS normal.

Mode 7: GPS, ADCEAU and AHRS failed.

System operation in the above modes is detailed on the following chart (legend and example screens follows chart):

PFD Functions:	Mode 0	Mode 1	Mode 2	Mode 3	Mode 4	Mode 5	Mode 6	Mode 7
Airspeed	OK	OK	-	OK	-	OK	-	-
Altimeter	OK	OK	-	OK	-	OK	-	-
Altimeter Set	OK	OK	-	OK	-	OK	-	-
Bank Scale	OK	OK	OK	-	OK	-	-	-
CDI	OK	1	OK	OK	-	-	OK	-
Runway	OK	1	-	-	-	-	-	-
Waypoint Pointer	OK	1	OK	7	-	-	7	-
Heading Scale	OK	OK	OK	7	OK	-	7	-
AGL Ind.	OK	2	4	OK	11	11	4	-
Flight Path Marker	OK	1 + 14	-	-	-	-	-	-
G-meter	OK	OK	OK	-	OK	-	-	-
Ground Track	OK	1	OK	7	-	-	7	-
Heading Indicator	OK	OK	OK	-	OK	-	-	-
Horizon	OK	OK	OK	-	OK	-	-	-
Mini-Map	OK	1	OK	7	-	-	7	-
Pitch Limit Indicator	OK	OK	-	8	-	8	-	-
Pitch Scale	OK	OK	OK	-	OK	-	-	-
Highway in the Sky	OK	1 + 15	-	-	-	-	-	-
Terrain / Obstruct	OK	-	-	-	-	-	-	-
Clock Functions	OK	OK	OK	OK	OK	OK	OK	OK
VSI	OK	OK	-	OK	-	OK	-	-
Waterline Symbol	OK	OK	5	13	5	13	13	13
Waypoint Symbol	OK	1	-	-	-	-	-	-
Waypoint Brg / Dist	OK	1	OK	OK	-	-	OK	-
Traffic	OK	OK	-	-	-	-	-	-
Speed Trend	OK	OK	-	-	-	-	-	-
Dynamic Stall Speed	OK	OK	-	8	-	8	-	-
ND Functions:								
Aircraft Position	OK	1	OK	OK	-	-	OK	-
Special Use Airspace	OK	1	6	9	-	-	6 + 9	-
Waypoint Pointer	OK	1	OK	9	-	-	9	-
Active Flight Plan Path	OK	1	OK	9	-	-	9	-
Glide Range	OK	1	-	10	-	-	-	-
Groundspeed	OK	1	OK	OK	-	-	OK	-
Ground Track	OK	1	OK	9	-	-	9	-
Heading Indicator	OK	OK	OK	-	OK	-	-	-
Navigation Symbols	OK	1	OK	9	-	-	9	-
Outside Air Temperature	OK	OK	-	OK	-	OK	-	-
Projected Path	OK	1	OK	-	-	-	-	-
Traffic	OK	OK	OK	OK	OK	OK	OK	OK
Terrain / Obstructions	OK	-	-	OK	-	-	-	-
Clock Functions	OK	OK	OK	OK	OK	OK	OK	OK
Waypoint Brg. / Dist.	OK	1	OK	OK	-	-	OK	-
Wind	OK	3	-	-	-	-	-	-
WX-500 Data	OK	OK	OK	OK	OK	OK	OK	OK
Compass Rose	OK	OK	OK	9	OK	-	9	-
Fuel Totalizer Functions	OK	1	-	OK	-	12	-	-
True Airspeed	OK	OK	-	OK	-	OK	-	-
Density Altitude	OK	OK	-	OK	-	OK	-	-

Note 1: Presented using inertial dead-reckoning based on last known wind information.

Note 2: Either radar altitude or barometric altitude less database elevation based upon inertial dead reckoning.

Note 3: Last known wind is saved during GPS/WAAS failure.

Note 4: Either radar altitude or geodetic altitude less database elevation.

Note 5: Waterline symbol expanded to large attitude bars.

Note 6: Special use airspace boundaries are drawn with bold lines due to lack of aircraft altitude data.

Note 7: Display aligned with aircraft track.

Note 8: Based upon 1G stall speed.

Note 9: Aligned with aircraft track in heading up mode.

Note 10: Presenting using last-known wind information and aligned with aircraft track in heading up mode.

Note 11: Only radar altitude presented when available.

Note 12: Only endurance is presented.

Note 13: Large attitude bars presented and X'd out.

Note 14: Flight Path Marker grayed after 1 minute to indicate degraded operation.

Note 15: Highway in the Sky removed after 1 minute.



AUDIBLE ANNUNCIATION

Component failures will result in yellow caution flags and a single voice annunciation identifying each failed component.

GPS Failure

GPS can degrade or fail as a result of loss of satellite information or GPS equipment failure. GPS degradation is annunciated with a “GPS LOI” caution flag and an aural tone to indicate GPS loss of integrity. In this mode, the GPS data loses the WAAS accuracy but remains as accurate as traditional GPS.

Further GPS degradation causes the EFIS to lose GPS updating of aircraft position, ground speed and ground track, and the ability to calculate wind information. A “GPS LON” caution flag is displayed to indicate GPS loss of navigation along with a “GPS failure, GPS failure” voice annunciation.

GPS failure results in the EFIS operating in “dead reckoning” mode. The EFIS continues to provide navigational position, groundspeed, and ground track information based upon the last known wind and current air data and heading. Terrain is removed immediately. The flight path marker is grayed out and the skyway is removed after one minute. In addition, a “DR ##.##” caution flag is displayed to show the pilot the length of time during which the EFIS has been dead reckoning.

NOTE:

WAAS or Fault Detection and Exclusion (FDE) must be available at the Final Approach Fix to continue an approach.

In the event of loss of GPS during an IFR approach procedure at or after the final approach fix and still IMC - Initiate the missed approach procedure.

The primary flight and navigation displays are affected as follows:



PFD page during GPS failure



ND page during GPS failure

CAUTION: In the event of loss of GPS, transition to other navigation sources as soon as possible. Following system dead reckoning guidance can lead to large position errors.

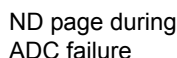
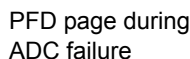
The accuracy of the dead reckoning solution depends upon how closely the actual wind matches the last known wind. It is important for the pilot to realize that, in the event of a wind mismatch, position errors will grow over time and can become large. Because of this, the dead reckoning solution is considered a short-term aid to position awareness in event of a GPS failure, and should not be used for continued navigation. The following factors should be considered in assessing the validity of the dead reckoning solution:

1. The length of time during which the EFIS has been dead reckoning. The longer the time, the greater the position error can be. As an example, with a 10 knot wind mismatch, the dead reckoning solution will be in error by 10NM after one hour.
2. Accuracy of the last known wind computation. During normal system operation, wind is calculated during periods of relatively wings-level flight (bank $< 6^\circ$). The wind calculation considers TAS, heading, GS and track. Factors that affect these parameters can cause inaccuracies in the calculated wind. The pilot should be aware of the following potential error sources:
 - TAS: True airspeed errors can be caused by airframe induced pitot-static inaccuracies, pitot-static system leaks or blockages, and inaccurate outside air temperature readings.
 - Heading: Heading errors can be caused by poor AHRS alignment, carrying iron-bearing materials in proximity to the AHRS, and operation of electric motors or other magnetic field inducing equipment. In addition, for the wind calculation to be accurate, heading must match the vector direction of TAS. As a rule of thumb, if the aircraft is being flown out of coordination, the wind calculation should be considered suspect.
 - GS: Poor satellite geometry can cause variations in the ground speed reading. Although this parameter is generally reliable, it should be considered suspect when a GPS “Loss of Integrity” exists.
 - Track: Poor satellite geometry can cause variations in the track reading. Although this parameter is generally reliable, it should be considered suspect when a GPS “Loss of Integrity” exists.
3. Atmospheric wind changes. Actual wind is rarely constant. The pilot should expect large wind changes with changes in altitude or in the presence of significant weather. The pilot

should also consider the effect of surrounding terrain upon wind.

Loss of GPS also affects the Flight Path Marker. While the vertical component of the Flight Path Marker is unaffected by a loss of GPS, the lateral component, based upon track is removed so the Flight Path Marker cages in the center of the screen. Unlike the dead reckoning position solution, the effects of loss of GPS on the accuracy of the Flight Path Marker are not cumulative. The Flight Path Marker remains an accurate tool for maintaining level flight during a GPS failure.

Failure of the ADC causes the loss of air data. This failure causes “NO AIR DATA” caution flag to be displayed. The primary flight and navigation displays are affected as follows:



*Failure of the ADC **outside** air temperature probe only will result in disabled TAS, OAT, DA, and wind displays and an **OAT SENSOR** caution flag. It will not affect other air data parameters.*

In the event of an ADC failure, revert to the standby altimeter and airspeed indicator.

AHRS Failure

Failure of the AHRS results in loss of attitude, magnetic heading and, G-force information. This failure causes the “NO ATTITUDE” caution flag to be displayed. The primary flight and navigation displays are affected as follows:



PFD page during AHRS failure

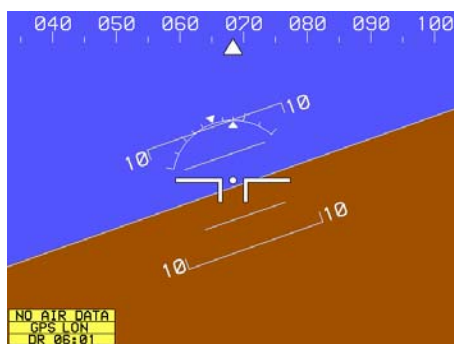


ND page during AHRS failure

In the event of an AHRS failure, revert to the standby attitude indicator for attitude and the standby directional gyro or compass for direction.

ADC and GPS Failure

When the GPS fails in conjunction with the ADC, the EFIS loses its navigational and three-dimensional presentation capabilities. In this condition, the PFD reverts to operation as a conventional ADI. The moving map page is selectable only for the purpose of showing third-party weather and TCAS/TCAD information. This failure causes “NO GPS” and “NO AIR DATA” caution flags to be displayed. The primary flight and navigation displays are affected as follows:



PFD page during
GPS and ADC
failure



ND page during
GPS and ADC

In the event of an ADC and GPS failure, revert to the standby airspeed indicator and altimeter and use other navigation sources.

ADC and AHRS Failure

ADC and AHRS failure causes the loss of air data, magnetic heading data, and attitude data. This failure causes “NO AIR DATA” and “NO ATTITUDE” caution flags to be displayed. The primary flight and navigation displays are affected as follows:



PFD page during ADC and AHRS failure



ND page during ADC and AHRS

In the event of an ADC and AHRS failure, revert to the standby attitude indicator, airspeed indicator, and altimeter.

GPS and AHRS Failure

With a GPS and AHRS failure, the EFIS loses its navigational, three-dimensional, attitude, and heading presentation capabilities. With this failure, the PFD presents air data only. The navigation display is only selectable for the purposes of showing passive lightning detection and traffic information. This failure causes the “NO GPS” caution flag and timer, and “NO ATTITUDE” caution flag to be displayed. The primary flight and navigation displays are affected as follows:



PFD page during
GPS and AHRS
failure

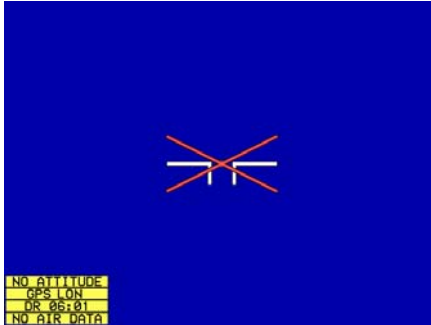


ND page during
GPS and AHRS
failure

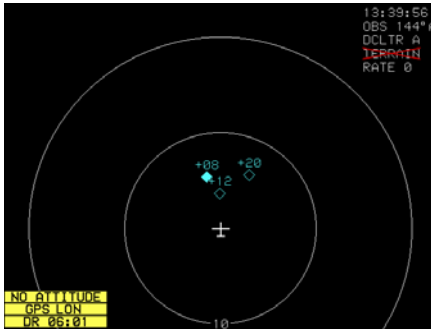
In the event of a GPS and AHRS failure, revert to the standby attitude indicator and directional gyro or wet compass and use other navigation sources.

GPS, ADC, and AHRS Failure

With a failure of all primary sensors, the only display page that retains a function is the moving map page for the display of third party weather, datalink, and TCAS/TCAD information. Both displays retain timer functions.



PFD during GPS, ADC, and AHRS failure



ND during GPS, ADC, and AHRS failure

In the event of a GPS and ADC and AHRS failure, revert to all standby instruments and use other sources for navigation.

Section 4

Button/Menu Functions

Overview

Pressing any of the peripheral buttons activates the function indicated by the button label. These are button functions.



In this example, pressing the MENU button displays the menus on the screen.

If the menu tiles are shown, pressing the button adjacent to the menu tile activates that menu. These are menu functions.



In this example, pressing the NRST button (ZOOM ON menu tile) turns the PFD zoom function on.

Some menu functions generate an immediate response, in which case the menu tiles disappear. Other menus display further “submenus” (indicated by a dot-dot after the menu name, example: **BUGS . .**).

When the menu appears in the lower-right corner of the screen, it is controlled by the right-hand control knob.



Turning the control knob steps through the scrolling menu (or alphanumeric characters) and the current selection is highlighted (as **WAYPOINT** is above). When the desired selection is highlighted, pushing the control knob enters the selection, which may activate a function or display yet another menu. When making alphanumeric entries, push the knob to advance to the next character.

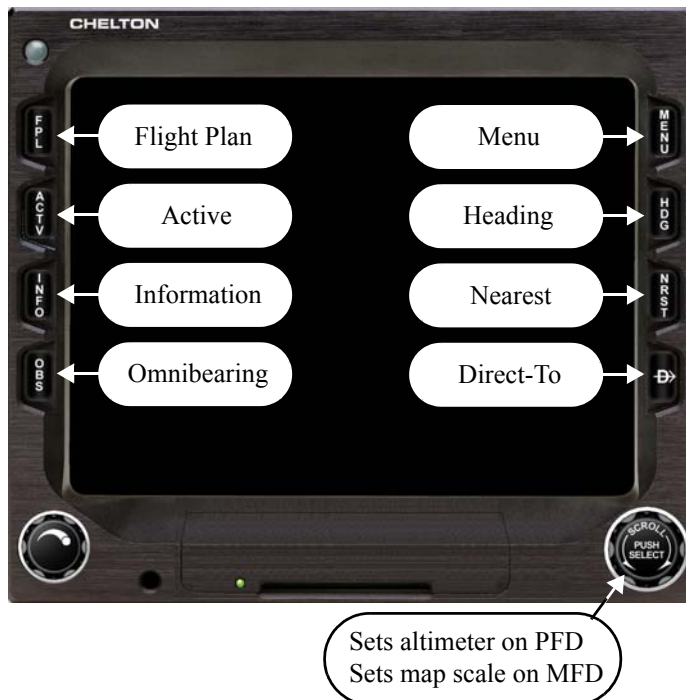


When within the menu structure, **EXIT** will always appear in the upper right corner and **BACK** will appear in the upper left corner when appropriate, indicating that a single step back to the prior menu position is possible. Use **EXIT** to get completely out of the menu structure from any level. Use **BACK** to step back one level to correct a mistake or make a different selection.

Many menu functions are the same on both the PFD and the ND, however there are some differences. In the following pages, the various menu functions are diagramed.

Button Functions

PFD and ND



FPL button: displays the flight plan menu.

ACTV button: displays the active flight plan menu.

INFO button: displays the information menu.

OBS button: displays the omnibearing selector menu.

MENU button: displays the first menu level associated with the current display screen. The first menu level automatically times out after 10 seconds if there are no subsequent user actions.

HDG button: displays the heading bug set menu.

NRST button: displays the “nearest” menu.

Direct-To button: displays the direct-to menu option.

Right-hand control knob: Function depends upon screen. On the PFD screen, rotating the encoder changes the altimeter setting. On all MFD screens other than the HSI (i.e., moving map, Strike or Traffic), rotating the encoder changes the display scale (clockwise = increase scale, counterclockwise = decrease scale). Pressing the encoder toggles between the PFD and ND screens on MFDs (i.e., not the pilot’s PFD).

A **MISSED** tile will appear adjacent to the top left button upon transitioning the Final Approach Fix. When the **MISSED** tile is pressed, the missed approach procedure will be armed (if pressed prior to missed approach point) or activated (if pressed after missed approach point).

A **CONTINUE** tile will appear adjacent to the top left button when in a holding pattern with further active flight plan legs after the holding pattern. When the **CONTINUE** tile is pressed, automatic waypoint sequencing will be re-enabled to allow normal sequencing to the leg after the holding pattern.

PFD Top Level Menus

PFD Only

(Shown by pressing the **MENU** button when on the PFD screen)



DESIG: creates a user waypoint at the current aircraft location. User waypoint will automatically be named “OF###” where ### is the next available overfly user waypoint number.

TIMER: displays the timer menu.

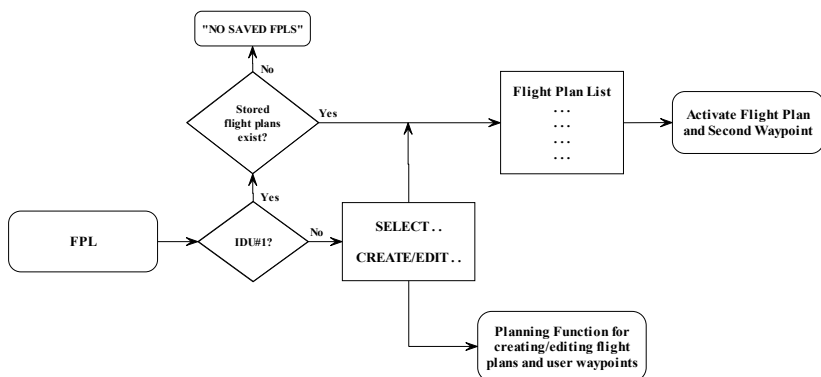
BUGS: displays the PFD bug set menu.

ZOOM ON / ZOOM OFF: toggles between wide and narrow field of view modes. **ZOOM ON** appears when the current mode is wide. **ZOOM OFF** appears when the current mode is narrow.

DCLTR: displays the PFD declutter menu.

Flight Plan Function

PFD and ND



PFD:

Upon activation of the flight plan function, the system will check for the existence of saved flight plans. If there are no saved flight plans, a **NO SAVED FPLS** menu will be displayed. Otherwise, a scrolling menu of saved flight plans will be presented.

MFD:

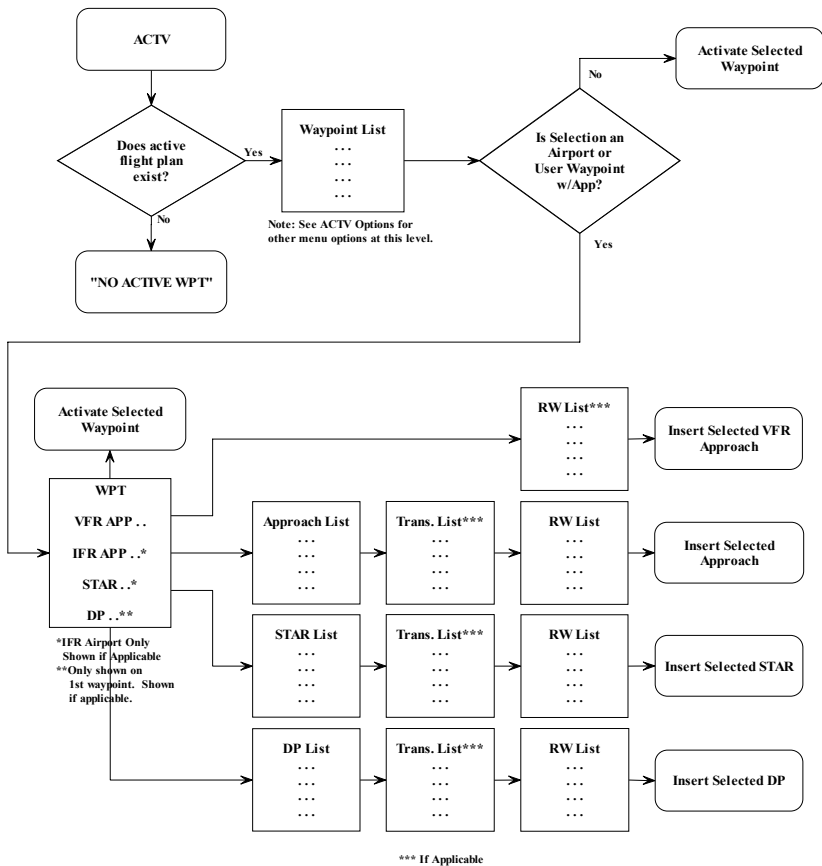
Upon activation of the flight plan function, the system will check for the existence of saved flight plans. If there are no saved flight plans, then the flight planning function will be activated. Otherwise, a menu will be presented allowing the user to either select a saved flight plan or enter the flight planning function. Selecting the saved flight plan menu option will lead to a list of saved flight plans.

Upon selection of a saved flight plan, the second waypoint in the flight plan will be activated (it assumes you are departing from the first waypoint in the flight plan). For example, when activating a flight plan from Teterboro to Manasas to Charlotte, Manasas will be automatically set as the active flight plan. If a flight plan is activated enroute, the most logical waypoint is automatically set as the active waypoint.

ACTV (Active) Function

PFD and ND

(Shown by pressing the **ACTV** button. Only shown when a waypoint or flight plan has been selected.)



When the **ACTV** button is pushed, the system will check for the existence of an active waypoint. If there is no active waypoint, a “NO ACTV WPT” advisory will be issued. Otherwise, a list waypoints in the active flight plan will be presented. The list will show each waypoint identifier, a symbol designating

waypoint type and what type of procedure (if any) the waypoint is associated with, and information related to the flight plan path between each waypoint. The current active waypoint will be designated by an asterisk. Any suppressed waypoint will be designated by brackets.

A suppressed waypoint is an airport associated with an approach procedure. After an approach procedure is activated, the associated airport is no longer part of the active flight plan for guidance purposes. However, the associated airport is still shown in the waypoint list so that it can be highlighted for information or to activate other procedures at the airport. Since there can only be one approach active at any given time, there can only be one suppressed waypoint at any given time.

It is possible to scroll through each waypoint of the active flight plan and it is also possible to scroll one position past the end of the active flight plan for the purpose of adding a waypoint to the end of the active flight plan.

Upon selection of a waypoint from the selection list, the system will check to see whether the selected waypoint is an airport or user waypoint with an approach bearing. If not, the system will make the selected waypoint active. Otherwise, an option list will be presented as follows:

WPT: makes the selected waypoint the active waypoint.

VFR APPR: If the selected waypoint is a user waypoint with an approach bearing, then a VFR approach to the user waypoint based upon the approach bearing will be created and the user waypoint will be suppressed. If the selected waypoint is an airport, then the user will be presented with a selection list of runways. After selecting a runway, a VFR approach to the runway will be created and the airport will be suppressed. Activating a VFR approach will automatically delete any pre-existing IFR or VFR approaches.

IFR APPR: If the selected waypoint is an airport with an IFR approach, then this option will be available. Upon selecting this option, a list of available approaches will be presented (if there are more than one), followed by a list of available transitions (if there are more than one), and a list of runways. After selecting

a runway, the appropriate IFR approach to the runway will be created and the airport will be suppressed. Activating an IFR approach will automatically delete any pre-existing IFR or VFR approaches. If there is a pre-existing STAR to the airport, then the IFR approach waypoints will be inserted after the STAR waypoints.

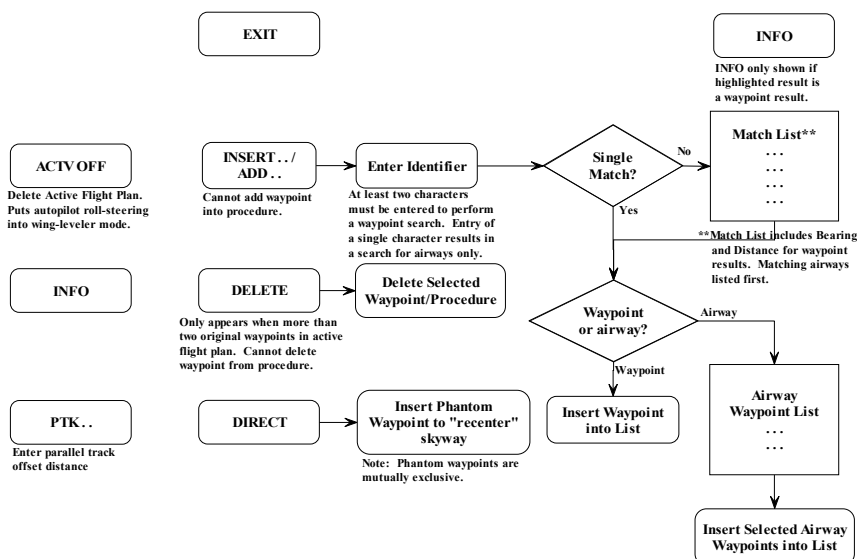
STAR: If the selected waypoint is an airport with a STAR, then this option will be available. Upon selecting this option, a list of available STARs will be presented (if there are more than one), followed by a list of available transitions (if there are more than one), and a list of runways. After selecting a runway, the appropriate STAR to the runway will be created. Activating a STAR approach will automatically delete any pre-existing STAR. If there is a pre-existing approach (IFR or VFR) to the airport, then the STAR waypoints will be inserted prior to the approach waypoints.

DP: If the selected waypoint is the first waypoint of the active flight plan and is an airport with a DP, then this option will be available. Upon selecting this option, the user will be presented with a selection list of DPs (if there are more than one), followed by a selection list of available transitions (if there are more than one), and a selection list of runways. After selecting a runway, the appropriate DP from the runway will be created. Activating a DP will automatically delete any pre-existing DPs.

ACTV (Active) Options

PFD and ND

(Shown by pressing the **ACTV** button. Only shown when a waypoint or flight plan has been selected.)



Various options appear at the same menu level as the waypoint list. These options allow various modifications to be made to the active flight plan as follows:

ACTV OFF: deletes the active flight plan. The user will be prompted to confirm deletion prior to completion of the operation.

INFO: activates the information menu option for the highlighted waypoint.

PTK: specifies a parallel offset distance for non-procedure segments of the active flight plan. The range of parallel offsets is from 20NM left of track to 20NM right of track in 1NM increments.

INSERT / ADD: used to insert or add a waypoint or airway into the active flight plan. If the highlighted position is one position past the end of the active flight plan, the tile will read **ADD**, otherwise the tile reads **INSERT**. When the highlighted waypoint is the second or subsequent waypoint of a procedure, the tile will not appear. The tile will also not appear when the highlighted waypoint is suppressed. When activated, the is prompted to enter an identifier. Performing a search for waypoints require the entry of at least two characters. If only one character is entered, only airways will be searched.

For waypoints, if there is a single result from the search, that waypoint will be inserted or added to the active flight plan. If there is no result from the search, the user will be re-prompted to enter an identifier. If there are multiple results from the search, a selection list with matching identifiers is presented and, upon selection, the selected waypoint will be inserted or added to the active flight plan. An **INFO** tile giving access to the information function for the highlighted waypoint will appear at this level to aid in selection.

For airways, a search is performed for all airways that go through the **previous** waypoint and match the entered identifier (when entering **J54**, for example). To get a list of all Victor airways that go through the previous waypoint, enter a **V**; for Jet routes, enter a **J**. If there is no result from the search, the user will be re-prompted to enter an identifier. If there are multiple results from the search, a selection list with matching airway identifiers will be presented and, upon selection, a list of airway waypoints will be shown so that the user can select the desired exit or transition point. Upon selecting the desired exit point, the necessary airway waypoints from the previous waypoint to the desired exit point are inserted or added to the active flight plan. Necessary airway waypoints are the **airway entry waypoint, the airway exit waypoint, turn waypoints, and VORs**.

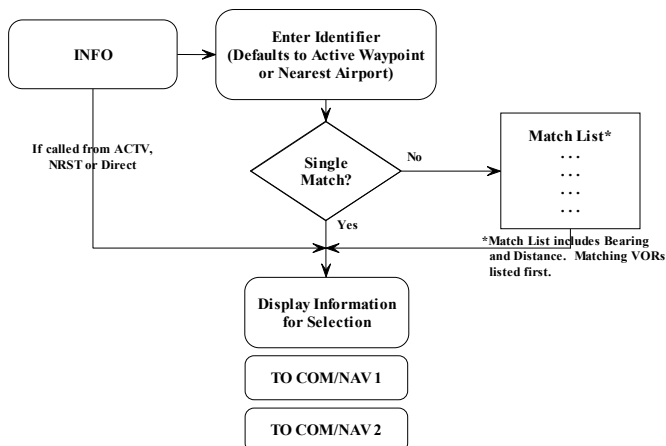
DELETE: If the highlighted waypoint is a non-procedure waypoint, then the function will delete the highlighted waypoint from the active flight plan. If the highlighted waypoint is part of a procedure, then the function will delete the entire procedure

from the active flight plan. The user will be prompted to confirm deletion prior to completion of the operation. This tile will not appear if the highlighted waypoint is a non-procedure waypoint and there are fewer than three non-procedure waypoints in the active flight plan. This is because an active flight plan must always have at least two non-procedure waypoints. The tile also will not appear when the highlighted waypoint is suppressed or when the highlighted position is one position past the end of the active flight plan.

Direct-To: will insert a phantom waypoint at the current aircraft location and re-center the aircraft on a direct route to the waypoint active. This tile will not appear when the highlighted waypoint is suppressed, when the highlighted position is one position past the end of the active flight plan, or when the highlighted waypoint is the second or subsequent waypoint of a procedure.

INFO Function

PFD and ND



If the **INFO** tile is activated from within the **ACTV**, **NRST** or **Direct-To** menus, then information on the highlighted waypoint from the applicable selection list will be shown directly. Otherwise, the system will check for a current active waypoint. If there is an active waypoint, then it will be the default entry. If there is no active waypoint, then the nearest airport be the default entry. If the default entry is accepted by the user, then its information will be shown. If the user rejects the default entry by entering identifier characters, then a search for matching identifiers will be performed. If there is a single result from the search, information for that result will be shown. If there is no result from the search, the user will be re-prompted to enter an identifier. If there are multiple results from the search, a selection list with matching identifiers will be presented to allow the user to select the desired identifier.

The amount and type of information presented depends upon the type of waypoint. For all types of waypoints, waypoint identifier, waypoint type, long name, bearing and distance, and latitude/longitude are presented. For navigation aids, navigation aid frequency will also be presented. For airports,

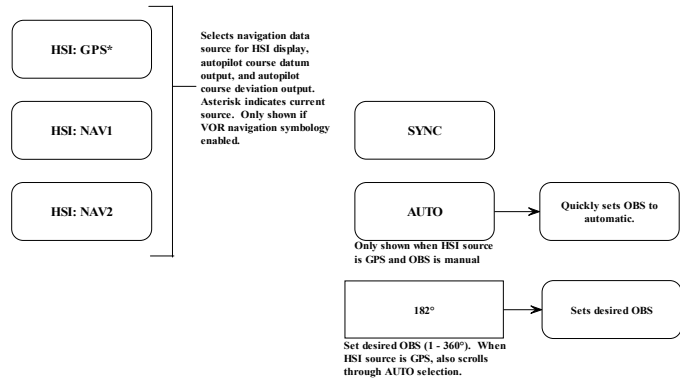
communication frequencies and airport runway data will also be presented.

If remote tuning of navs and coms is enabled and a single frequency is associated with the waypoint, tiles are shown to allow sending of the frequency to remote NAV or COM radios. If more than one frequency is associated with the waypoint (airport waypoint, for example), tiles are shown to allow sending of a frequency to remote NAV or COM radios when a frequency is highlighted in the INFO block. If the frequency is less than 118MHz, the tiles will read **TO NAV1** and **TO NAV2**. If the frequency is greater than or equal to 118MHz, the tiles will read **TO COM1** and **TO COM2**.

The information window is closed by pushing the control knob.

OBS (Omnibearing Selector) Function

PFD and ND

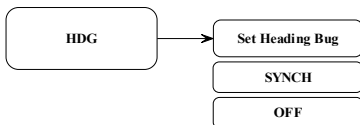


The **OBS** function allows the user to control the setting of the omnibearing selector for purposes of showing course deviations. The OBS for GPS/WAAS allows the user to specify either a manual OBS setting, or an automatic OBS setting in which the current active OBS is controlled by the active flight plan. The OBS for VOR allows the user to specify the active OBS setting for the VHF navigation function. Manual GPS/WAAS OBS setting and VOR OBS setting are settable in increments of 1°.

With optional VHF navigation, the OBS function also permits the user to select either GPS, NAV1, or NAV2 as the HSI source. The HSI source selects which navigation source is used to generate HSI guidance symbology. HSI source also selects which navigation source is used for autopilot course datum and course deviation signals. When HSI source is set to NAV1 or NAV2 and flight director symbology is not enabled, HSI symbology is automatically enabled on the PFD. A synchronization function synchronizes the Manual GPS/WAAS OBS setting or VOR OBS setting (depending upon HSI source) to aircraft heading.

HDG (Heading) Function

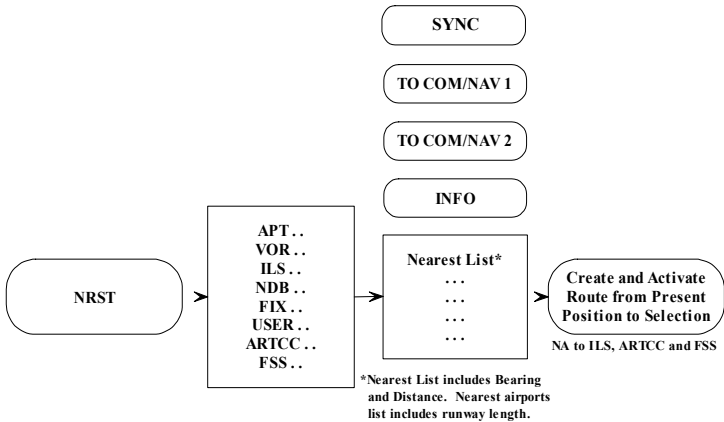
PFD and ND



The heading bug function allows the user to the heading bug in increments of 1°, synchronize the heading bug to current heading, or turn the heading bug off.

NRST (Nearest) Function

PFD and ND



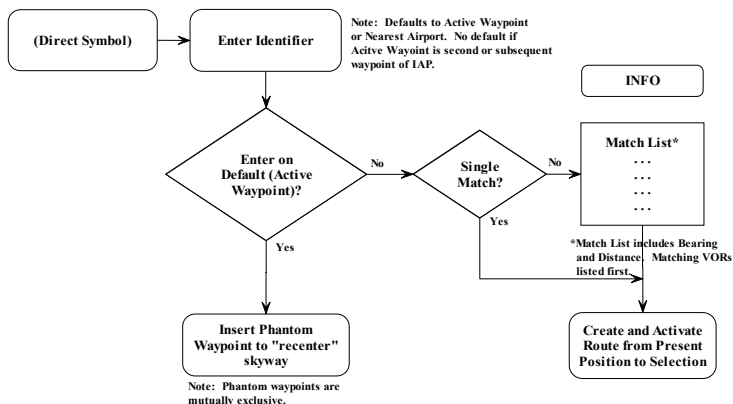
Upon pressing the **NRST** button, an option list appears to allow the user to select from a list of the nearest airports, nearest VORs, nearest ILSs, nearest NDBs, nearest fixes, nearest user waypoints (if any have been created), nearest ARTCCs, or nearest FSSs. Upon selecting a waypoint category from the option list, a selection list of waypoints matching the waypoint category will appear. The selection list includes identifier, bearing and distance to the waypoint. The selection list for airports also contains an indication of the longest runway length at the airport. The selection list for airports, VORs, ILSs, NDBs, ARTCCs and FSSs includes an associated frequency (CTAF in the case of airports). If remote tuning is enabled, tiles are shown to allow transmission of the associated frequency to remote NAV or COM radios.

An **INFO** tile activates the information function and provides further information on the highlighted waypoint. Upon selecting an airport, VOR, NDB, fix or user waypoint, a new active flight plan is created from present aircraft position to the selected waypoint.

A **SYNC** tile synchronizes the OBS to the ILS course.

Direct-To Function

PFD and ND



Upon pressing the **Direct-To** button, the system will check for a current active waypoint. If there is an active waypoint and the waypoint is not the second or subsequent waypoint of an IFR approach procedure, then the active waypoint will be the default entry. If there is no active waypoint, then the nearest airport will be the default entry.

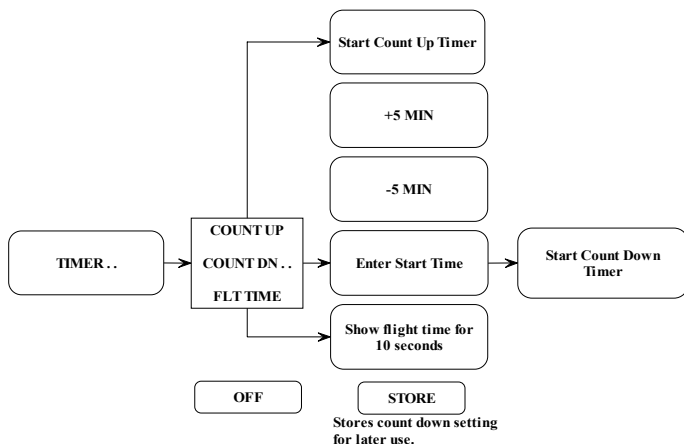
If the default entry is the active waypoint and is accepted by the user, then a phantom waypoint will be inserted at the current aircraft location and the skyway will be “re-centered” to provide guidance directly to the new active waypoint. The rest of the active flight plan will remain unchanged. If the default entry is not the active waypoint and is accepted by the user, then a new active flight plan will be created from present aircraft position to the selected waypoint.

If the user rejects the default entry by entering identifier characters, then a search for matching identifiers will be performed. If there is a single result from the search, then a new active flight plan is created from present aircraft position to the result. If there is no result from the search, the user will be re-prompted to enter an identifier. If there are multiple results from the search, a list with matching identifiers will be

presented and, upon selection, a new active flight plan will be created from present aircraft position to the selected waypoint. An **INFO** tile giving access to the information function for the highlighted result will appear at this level to aid in selection.

Timer Function

PFD and ND

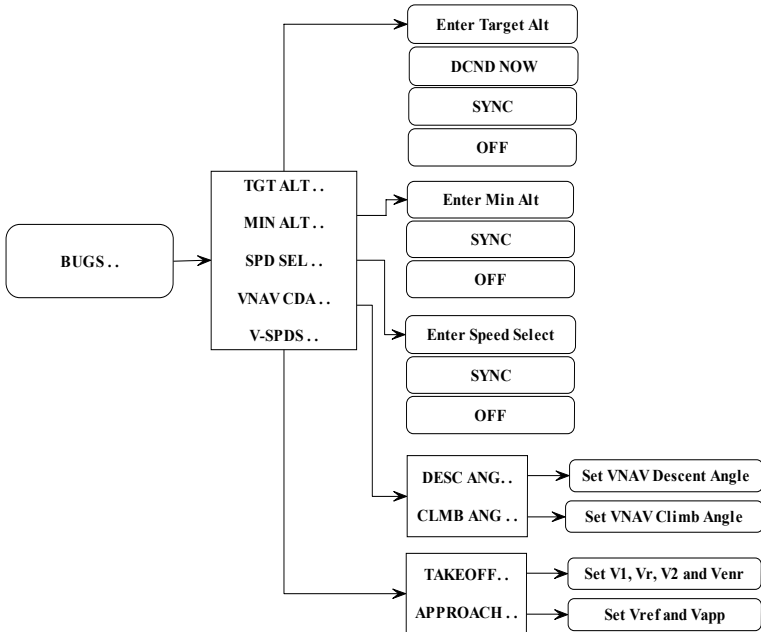


Upon selecting the timer function, a menu will appear to let the user choose the count up timer, the count down timer, or the flight time display. An **OFF** tile will also appear at this level to allow the user to turn off any active timer functions. If the user selects the count up timer, the count up timer will be activated immediately.

If the user selects the count down timer, the user will be prompted to enter a start time from which the count down begins. Shortcut tiles to quickly add or decrease by 5 minute increments are provided. After entering a start time, the user will be able to either start the count down timer or select the **STORE** tile to store the start time for later use. If the user selects the flight time display option, the current elapsed time since system power up will be displayed for 10 seconds or until any key is pressed.

Bug Set Function

PFD Only



Upon selecting the PFD bugs function, the user is presented with an option list to choose either setting a target altitude, setting a minimum altitude, setting an airspeed bug, setting the VNAV climb or descent angle, or setting V-speeds. Selecting the target altitude option allows the user to either synchronize the target altitude to current altitude, turn the target altitude off or set the target altitude in increments of 100 feet (enroute and terminal mode) or 10 feet (approach mode). If the target altitude is below current altitude, a **DCND NOW** tile appears to allow the user to control the descent guidance. Selection of the **DCND NOW** tile creates a "Bottom of Descent" ("B/D") waypoint that causes the skyway to immediately descend at the VNAV descent angle setting.

Selecting the minimum altitude option allows the user to either synchronize the target altitude to current altitude, turn the minimum altitude off, or set the minimum altitude in increments of 10 feet.

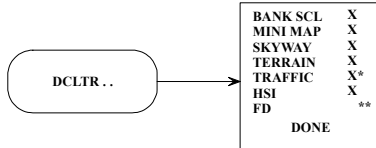
Selecting the airspeed bug option allows the user to either synchronize the airspeed bug to current airspeed, turn the airspeed bug off, or set the airspeed bug in increments of 1 knot indicated airspeed.

Selecting the VNAV climb or descent angle option brings up a further option list for setting either climb angle or descent angle. Selecting either option allows the user to set the climb angle or angle in increments of 0.1° . Corresponding feet per nautical mile is shown adjacent to the climb or descent angle setting.

Selecting the V-speed option allows the user to set takeoff V-speeds (V_1 , V_R , V_2 and V_{ENR}) or approach V-speeds (V_{REF} and V_{APP}).

PFD Declutter Function

PFD Only



* Only shown with optional TCAD installed.

**Only shown with optional FD enabled. Note: HSI and FD are mutually exclusive.

Upon activating the PFD declutter function, an list of declutter items will be shown. It is possible to select or deselect the following items:

1. Bank angle scale (toggle between full-time display and auto declutter at small bank angles).
2. PFD mini-map.
3. Skyway guidance symbology.
4. Perspective terrain and obstacle depiction.
5. Perspective traffic depiction.
6. HSI symbology.
7. Flight director symbology (only shown with optional flight director symbology option and mutually exclusive with HSI symbology).

Navigation Display Top Level Menus

ND Only

(Shown by pressing the **MENU** button when on the MFD screen)



FAULTS: displays the fault display menu.

CLR STRKS: displays the strike clear option for the Goodrich WX-500. This menu option will only appear on the ND screen and Strike screen when the WX-500 option is enabled.

DESIG: Same function as PFD Top Level Menu.

TIMER: Same function as PFD Top Level Menu.

SET FUEL: displays the fuel totalizer set menu.

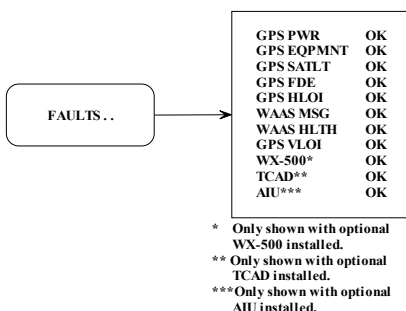
DISPLAY: displays the MFD screen display select menu.

FORMAT or **RMI ON / RMI OFF**: On screens other than the HSI screen, displays the appropriate screen format menu option. On HSI screen with optional VHF navigation, toggles showing of radio magnetic indicator. **RMI ON** appears when the current mode is radio magnetic indicator off. **RMI OFF** appears when the current mode is radio magnetic indicator on.

Faults Function

ND Only

(See System Overview, GPS/WAAS Receiver, page 28, for information on GPS Faults.)



Upon selecting the MFD faults menu, the status of the following system parameters will be displayed:

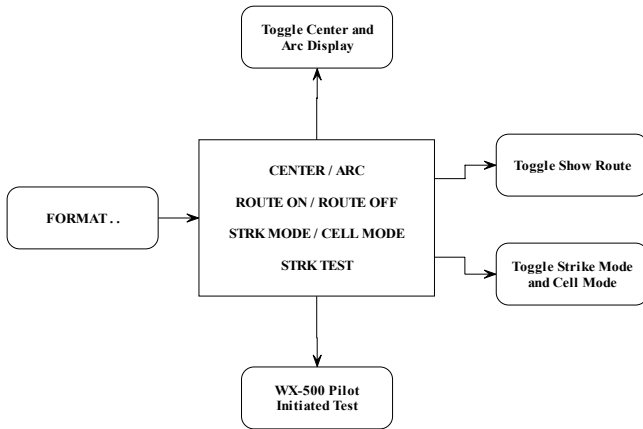
1. GPS/WAAS loss of navigation due to absence of power ("GPS PWR").
2. GPS/WAAS loss of navigation due to probable equipment failure ("GPS EQPMNT").
3. GPS/WAAS loss of navigation due to inadequate satellites to compute a position solution ("GPS SATLT").
4. GPS/WAAS loss of navigation due to a position failure that cannot be excluded within the time to alert ("GPS FDE").
5. GPS/WAAS loss of horizontal integrity monitoring and loss of navigation due to loss of horizontal integrity monitoring ("GPS HLOI").
6. GPS/WAAS loss of navigation due to no valid WAAS message received for 4 seconds or more.
7. GPS/WAAS loss of navigation due to insufficient number of WAAS HEALTHY satellites ("WAAS HLTH").

8. If the WX-500 option is enabled, loss of communications with the WX-500 ("WX-500").
9. If the traffic option is enabled, loss of communications with the traffic sensor ("TRFC").
10. If the analog interface option is enabled, loss of communications with the analog interface ("AIU").

Strike Format Function

ND Only

(Only shown with optional WX-500 installed).



Upon selecting the MFD format function when in the Strike screen, a menu appears with the following options:

CENTER / ARC: toggles between centered and arc lightning strike screen display format.

ROUTE ON / ROUTE OFF: toggles showing/not showing the active flight plan route on the lightning strike screen.

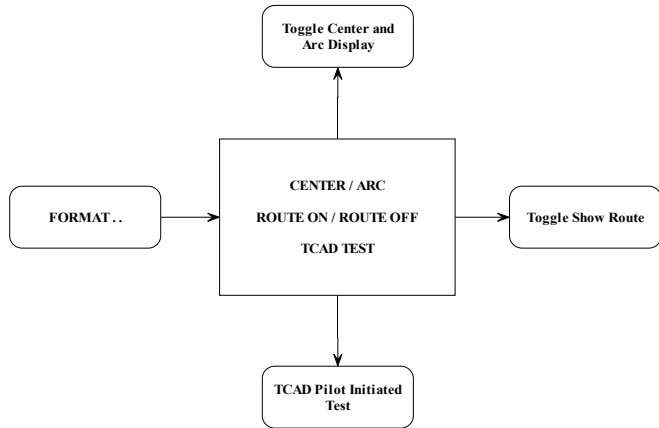
STRK MODE / CELL MODE: toggles between strike mode/ strikes and cell mode on the lightning strike screen.

STRK TEST: activates the WX-500 pilot initiated test function.

Traffic Format Function

ND Only

(Only shown with optional TCAD installed.)



Upon selecting the MFD format function when in the Traffic screen, a menu will appear with the following options:

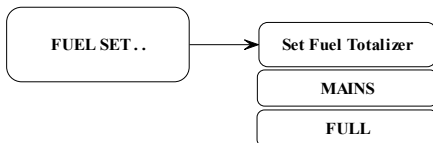
CENTER / ARC: toggles between a centered and arc traffic screen display format.

ROUTE ON / ROUTE OFF: toggles showing/not showing the active flight plan route on the traffic screen.

TCAD TEST: activates the TCAD pilot initiated test function.

Fuel Set Function

ND Only



The fuel totalizer quantity setting function allows the user to set the fuel totalizer quantity in increments of volume units (volume units depends upon the aircraft-specific configuration of the system, i.e. pounds, gallons, etc.).

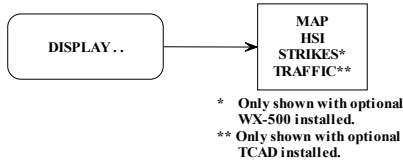
The **MAINS** menu tile sets the quantity to the “fuel tabs” or “main tanks” fuel capacity.

The **FULL** menu tile sets the quantity to the total aircraft fuel capacity (full tanks or mains plus tips, for example).

This menu also displays the total fuel flow shown in parenthesis next to the total fuel remaining.

MFD Display Function

ND Only



The Display function allows the user to select which MFD screen to display. Options include:

MAP: shows the moving map screen.

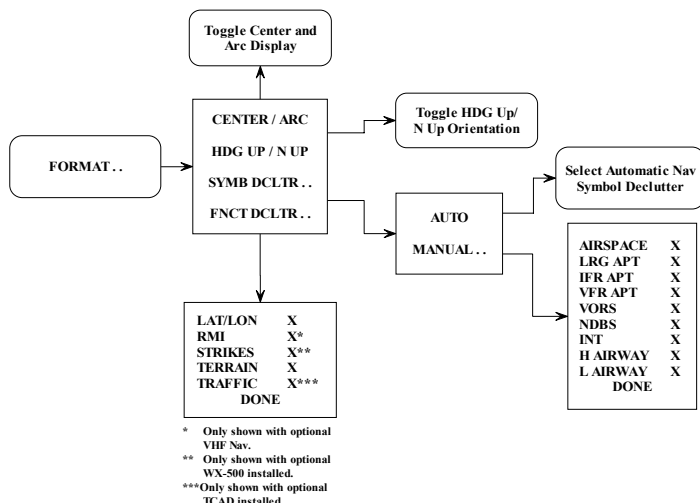
HSI: shows the HSI screen.

STRIKES: shows the lightning strike screen. This option is only available if the WX-500 option is enabled.

TRAFFIC: shows the traffic screen. This option is only available if the TCAD option is enabled.

Moving Map Format Function

ND Only



Upon selecting the MFD format function when on the moving map screen, an menu appears with the following options:

CENTER / ARC: toggles between centered and arc display format.

HDG UP / N UP: toggles between a heading up and a True North up display format.

SYMB DCLTR: activates an menu that allows the user to choose either automatic navigation symbol declutter or manual navigation symbol declutter. If the user chooses manual navigation symbol declutter, a further menu appears to allow the user to individually toggle airspace, large airports (IFR and longest runway > 8100'), IFR airports, VFR airports, VOR's, NDBs, fixes, high altitude airways, or low altitude airways. Turning on VFR airports also turns on large airports and IFR airports. Turning on IFR airports also turns on large airports. Turning off large airports also turns off IFR airports and VFR airports. Turning off IFR airports also turns off VFR airports.

FNCT DCLTR: activates a menu that allows the user to individually toggle display of current latitude and longitude, display of RMI needles (if VHF navigation option is enabled), display of lightning strikes (if WX-500 option is enabled), display of terrain, and display of traffic (if TCAD option is enabled).

Section 5

Step-by-Step Procedures

Setting Altimeter

PFD and Reversionary PFD Only

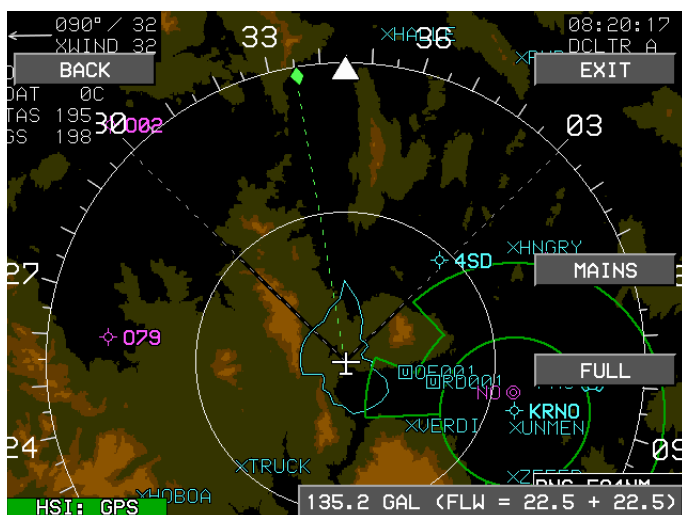
The altimeter is set automatically on startup based on the touchdown zone elevation of the nearest runway.

To change the altimeter, turn the control knob to enter the desired setting and push to enter.

Setting Fuel Quantity

ND Only

1. Upon startup, the #1 MFD will prompt for adding fuel; otherwise, press the **MENU** button and select the **SET FUEL . .** menu, then push to enter. The amount displayed in the lower-right corner is the amount remaining.



2. Turn control knob to set fuel quantity on board or press **FULL** menu button to set to total usable value or press **MAINS** to enter a preset partial amount (configured at installation). Current fuel flow for each engine is indicated in tenths in parenthesis.
3. Push control knob to enter.

Flight Plans

Flight plans are stored routes that can be used over and over without having to re-enter the waypoints each time. A flight plan consists of at least two waypoints (a start and an end) and can have up to 40 waypoints. Flights requiring more than 40 waypoints can be divided into two or more flight plans.

All flight planning is done using a built-in graphical interface. Flight plans can be created, edited, or reversed on the MFD only, and they are automatically cross filled to other displays. They can be activated from either the PFD or MFD. Once activated, a flight plan can be edited en route without affecting the stored flight plan. A total of 100 flight plans can be stored in the system.

Create and Store a Flight Plan

MFD Only

1. Press the **FPL** button.
2. Turn control knob to highlight **CREATE - EDIT . .** , then push to enter.
3. **CREATE FLIGHT PLAN** will be highlighted. Push to enter.

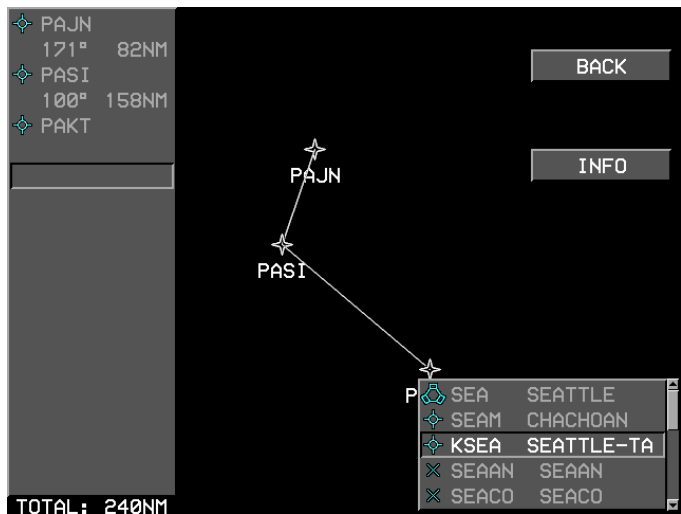


4. The graphical flight planner will be displayed. Press **ADD** and the waypoint entry boxes will appear in the lower right corner of the display. Enter the first waypoint of your flight plan - turn the control knob to select an alphanumeric character and push enter to advance to the next character. Begin the waypoint entry with the ICAO identifier for airport region (K for continental U.S., PA for Alaska, etc.) if

entering an airport. This not necessary but may save time by shortening the list of possible matches.



5. Enter at least one character. Advance through any remaining blank character spaces by simply pushing the control knob. A list of possible matching waypoints will be displayed.



Enter Victor Airways and Jet Routes by their identifier (J54, V254, etc.) or some portion thereof. When flight planning using airways or routes, you will be prompted for the fix from which you will be departing the route. For more information, see **Using Airways (Victor/Jet Routes)**, page 5-42

6. If there is no exact match, turn the control knob to select desired waypoint, and push to enter.
An exact match will be accepted and entered immediately.

The **INFO** button may be used to get Jeppesen NavData information about waypoints as they are added.

7. Repeat for all waypoints in route.
8. Press **BACK** at any point to back up during selection of alphanumeric characters.
9. Press **SAVE-EXIT** when finished to save and return to previous screen.

The flight plan will be automatically named with the first and last waypoint and added to the flight plan list.

Multiple flight plans between the same airport pairs are named sequentially by appending the name with a (1), (2), (3), etc. for each additional flight plan.

Activate a Stored Flight Plan

PFD and ND

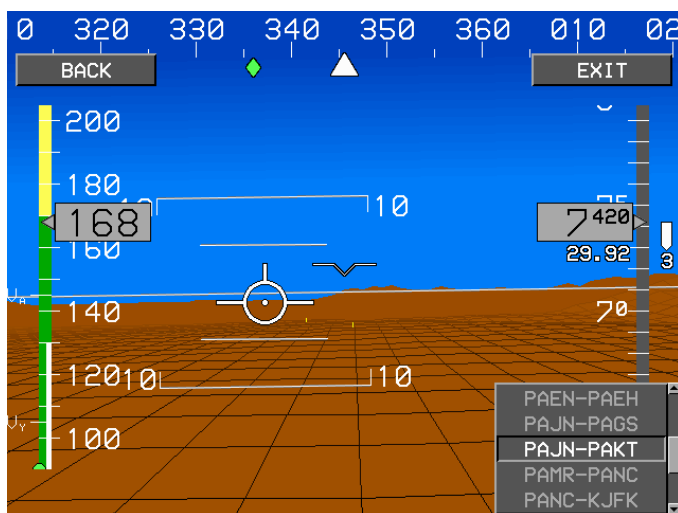
1. Press the **FPL** button.

On the PFD, a list of flight plans stored in the EFIS will be displayed.

On the MFD, **SELECT** will be highlighted...

Push the control knob to display a list of flight plans stored in the EFIS.

2. Rotate the control knob through the flight plans. When the desired flight plan is highlighted, push the control knob to enter.



NOTE:

NO SAVED FPLS will be displayed if no flight plans have been created and stored.

Edit a Stored Flight Plan

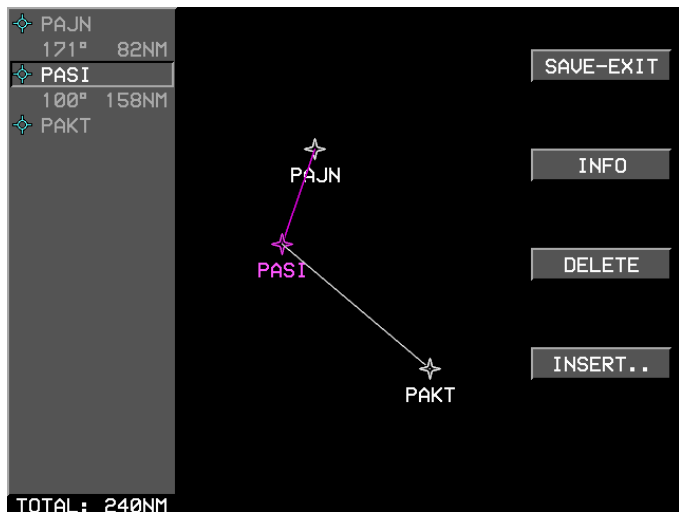
1. Press the **FPL** button.
2. Turn control knob to highlight **CREATE - EDIT . . .**, then push to enter.
3. Turn control knob to highlight **EDIT FLIGHT PLAN**, then push to enter.



4. Turn control knob to highlight the flight plan you wish to edit, then push to enter.



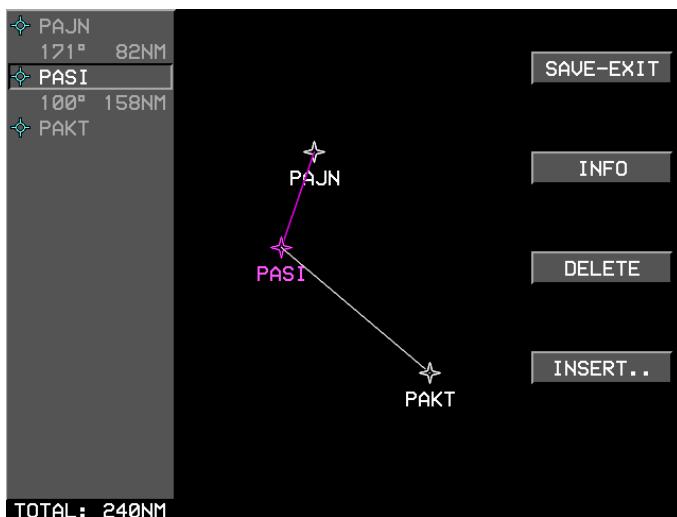
5. Turn control knob to highlight the waypoint you wish to edit, then push to enter.



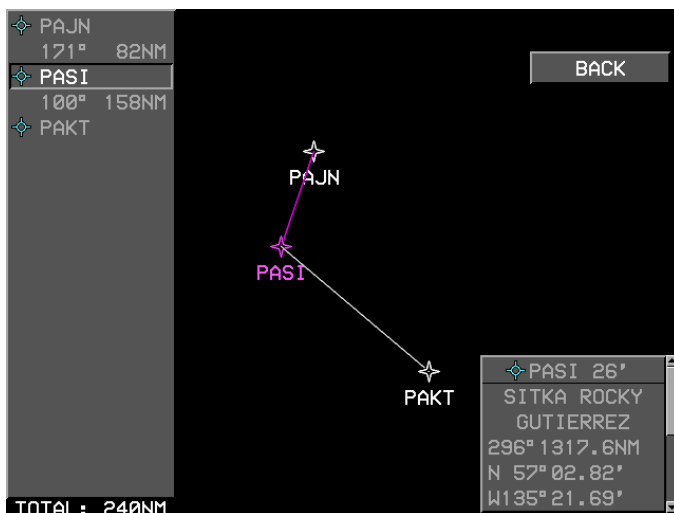
6. Select **INSERT . .** to add a new waypoint before the highlighted waypoint. Highlighted waypoints may be changed by turning the control knob.

Or:

Select **DELETE** to delete the highlighted waypoint.



Select **INFO** to display additional information about the highlighted waypoint.



7. Scroll to the end and press **ADD . .** to add waypoints to the end of the route.
8. Press **BACK** to return to **EDIT** page.
9. Press **SAVE-EXIT** when finished to save and return to previous screen.

Reverse a Stored Flight Plan

1. Press the **FPL** button.
2. Turn control knob to highlight **CREATE - EDIT . .**, then push to enter.
3. Turn control knob to highlight **REVERSE FLIGHT PLAN**, then push to enter.



4. Turn control knob to highlight flight plan to be reversed, then push to enter.

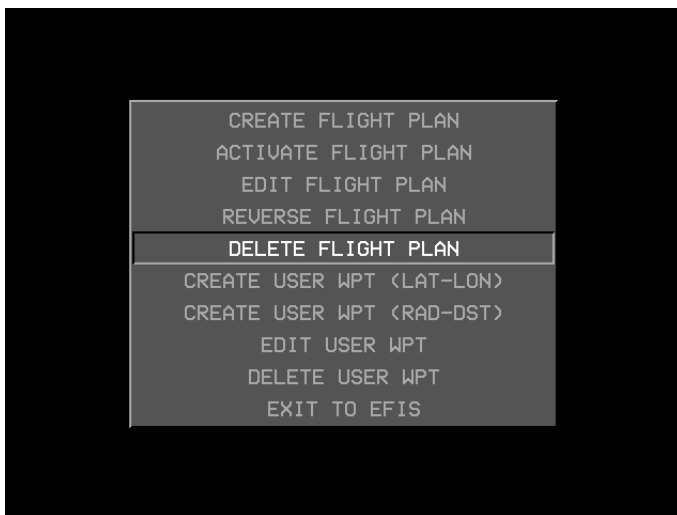


Reversed flight plan will be added to flight plan list. It may then be selected for active use in the normal manner.

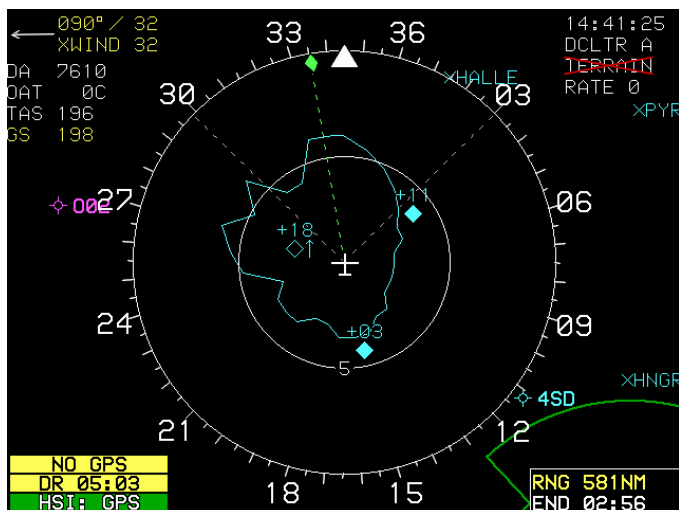
5. Press **BACK** to return to previous screen.

Delete a Stored Flight Plan

1. Press the **FPL** button.
2. Turn control knob to highlight **CREATE - BACK . .**, then push to enter.
3. Turn control knob to highlight **DELETE FLIGHT PLAN**, then push to enter.



4. Turn control knob to highlight flight plan to be deleted, then push to enter.



You will be asked for confirmation to delete the highlighted flight plane. Push enter to confirm or push **BACK** to return to the previous menu.

5. Press **BACK** to return to previous screen.

Transfer Flight Plans Between Aircraft

There may be times when it is necessary to transfer the flight plans stored on one system to a system in another aircraft. This is done using the Ground and Maintenance Utility.

1. With the power OFF, insert a data card into the primary flight display (gold side up).
2. Power the system ON and select the **DOWNLOAD ROUTES AND USER WAYPOINTS** option using the control knob (turn to scroll, push to enter).

Chelton Flight Systems Ground and Maintenance Functions:

```
Run Demonstrator/Training Program
Update Databases, Limits and Application
Download Log Files
Fuel Tank Calibration (CPU#0 or CPU#1 Only)
View Fuel Tank Calibration Map (CPU#0 or CPU#1 Only)
View bitlog.dat
L3 WX-500 Maintenance Utility (CPU#0 or CPU#1 Only)
Ryan TCAD Maintenance Utility (CPU#0 or CPU#1 Only)
Terrain Data Verification
Display Internal Temperature
Download Routes and User Waypoints
Upload Routes and User Waypoints
View System Limits (CPU#0 or CPU#1 Only)
```

3. Power the system OFF and remove the data card
4. With the power OFF, insert a data card into the primary flight display in the other aircraft (gold side up).

5. Power the system ON and select the **UPLOAD ROUTES AND USER WAYPOINTS** option using the control knob (turn to scroll, push to enter).

```
Chelton Flight Systems Ground and Maintenance Functions:
```

```
Run Demonstrator/Training Program
Update Databases, Limits and Application
Download Log Files
Fuel Tank Calibration (CPU#0 or CPU#1 Only)
View Fuel Tank Calibration Map (CPU#0 or CPU#1 Only)
View bitlog.dat
L3 WX-500 Maintenance Utility (CPU#0 or CPU#1 Only)
Ryan TCAD Maintenance Utility (CPU#0 or CPU#1 Only)
Terrain Data Verification
Display Internal Temperature
Download Routes and User Waypoints
Upload Routes and User Waypoints
View System Limits (CPU#0 or CPU#1 Only)
```

6. Power the system OFF and remove the data card

NOTE:

The system cannot enter flight mode while the data card is in the slot.

Waypoints

Nearest Waypoint

1. Press the **NRST** button.
2. Turn control knob to highlight nearest airport, VOR, ILS, NDB, fix, user waypoint, then push to enter. Nearest ILS, ARTCC, and FSS are shown as well but may not be selected for navigation.



3. A list of waypoints will be displayed, each with bearing, distance, longest runway, and frequency as applicable. Turn control knob to highlight desired choice, then push to enter.



Bearing to selected waypoint will be displayed with distance in NM, followed by longest runway, then common or tower frequency.

If a frequency is displayed in this step, it may be highlighted and sent to a radio. See **Tuning Radios using the EFIS, page 5-89** for more information.

NOTE:

*Using **NRST** or entering a new destination waypoint using **Direct-To** will override an existing flight plan or waypoint.*

Direct to Any Waypoint

1. Press the **D→** dedicated button.
2. If an active waypoint exists, it will be entered as the default. Pushing the control knob will create a phantom waypoint at the current aircraft location and recenter the skyway and CDI directly from the present position to the waypoint. The leg prior to the phantom waypoint is designated a discontinuity, see **Discontinuity**, page 3-122.

If there is no active waypoint, the nearest airport will be the default entry.

3. If desired, enter the identifier of another waypoint – turn the control knob to select an alphanumeric character and push to enter and advance to the next character. Press **BACK** if you need to back up. Entering at least one character and advancing through the remaining blank character spaces will display a list of potential waypoints if there is no exact match.



4. The **INFO** button may be used to get Jeppesen NavData information about a waypoint before it is activated.

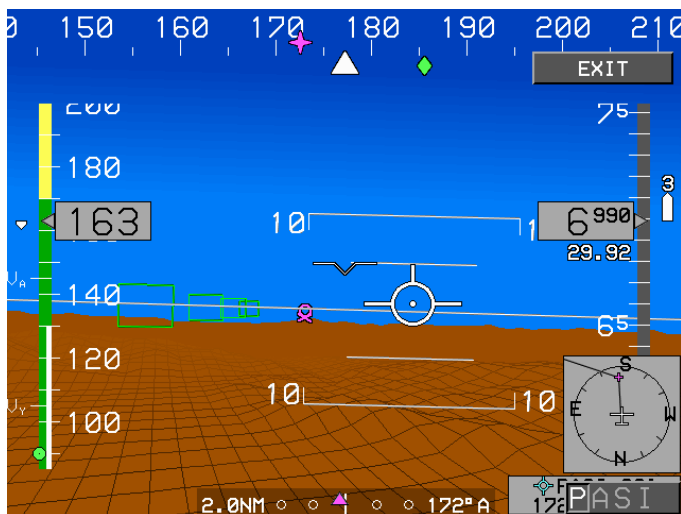
5. Turn control knob to highlight desired waypoint, push to enter. Direct course to selected waypoint will be displayed with distance in NM.

NOTE:

*Unless the default (current active waypoint) is accepted, using **Direct-To** will override an existing flight plan or waypoint. To go directly to another waypoint within the active flight plan, press the **ACTV** button, scroll to the desired waypoint, then push the **➔** button.*

Recenter on Route

1. Press the **D➔** dedicated button.
2. The active waypoint identifier will be displayed in the character spaces (do not change it).



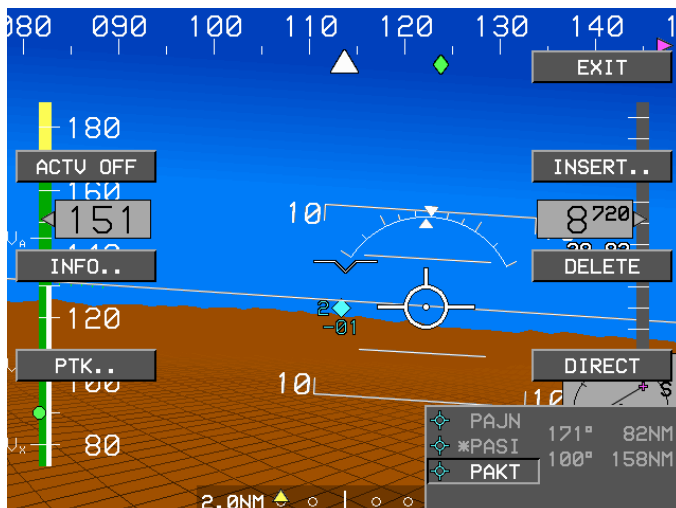
3. To fly direct from present position (re-center the skyway/courseline), push control knob to enter.

Direct course to selected waypoint will be displayed from aircraft's current position.

NOTE:

Using **Direct-to** and entering another waypoint identifier (other than the default) will override an existing flight plan or waypoint.

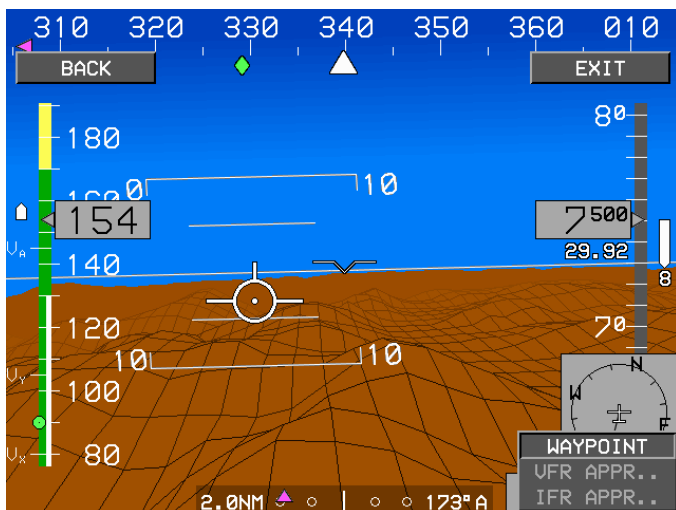
1. Press the **ACTV** Button. A list of waypoints in the current flight plan will be displayed. An asterisk indicates the active waypoint.
2. Turn control knob to highlight desired waypoint, then push to enter.



3. If waypoint is **not an airport or user waypoint**, waypoint is activated immediately and a direct course to selected waypoint will be displayed.

If waypoint is an **airport**, a list with the airport reference

point (**WPT**), **VFR** and **IFR** approaches, **DPs**, and **STARs** will be displayed.



4. If the waypoint is an airport, turn control knob to highlight **WPT**, and push to enter. Selected airport will be activated as a waypoint and the courseline to the waypoint will be displayed in magenta.

NOTE:

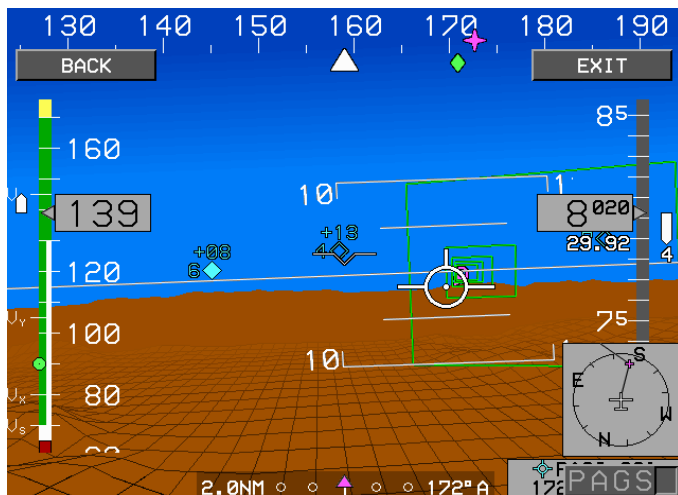
This will not redraw the route on the map from the present position to the active waypoint, it just specifies a new active waypoint without altering the route.

*To go directly from the present position to a different waypoint within an active flight plan, press the **ACTV** button, select the desired waypoint, then press the **➡** button. Choosing a new active waypoint will, however, command the autopilot to fly directly to the waypoint and intercept the courseline.*

1. Press the **ACTV** button.
A list of waypoints in the current flight plan will be displayed.
2. Turn control knob to highlight the waypoint *before which* you wish to add a new waypoint or airway (an airway can only be added after a waypoint that is part of an airway).



3. Select the **INSERT...** menu.



4. Enter the identifier of the desired waypoint - turn the control knob to select an alphanumeric character and push to enter and advance to the next character. Press **BACK** at any point to back up. Enter Victor Airways and Jet Routes using their identifier (V254, J54), or portion thereof, and then selecting the transition fix when prompted (see **Using Airways (Victor/Jet Routes)**, page 5-42).

Entering at least one character and advancing through the remaining blank character spaces will display a list of waypoints if there is no exact match. An exact match will be accepted and entered immediately.

5. The **INFO** button may be used to get Jeppesen NavData information about a waypoint before it is activated.
6. Turn control knob to highlight desired waypoint, push to enter. Waypoint or route will be added to current flight plan.

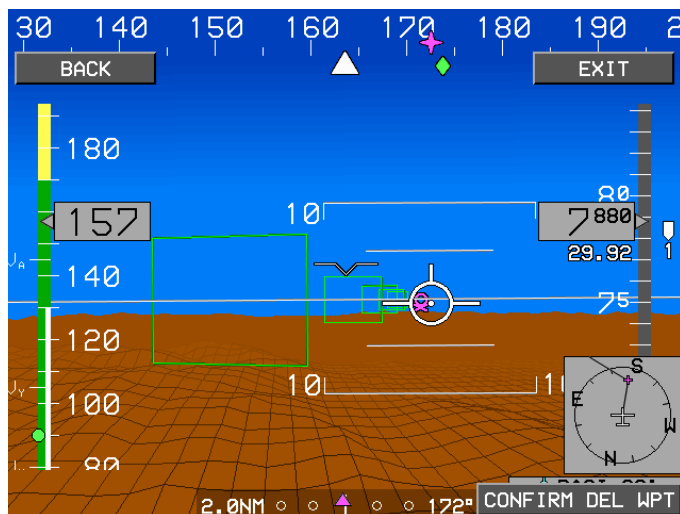
Add as many waypoints as necessary, then scroll to the desired active waypoint and push to enter.

See **ACTV (Active) Options, page 4-10** for more information.

1. Press the **ACTV** button
A list of waypoints in the current flight plan will be displayed.
2. Turn control knob to highlight the waypoint you wish to delete.



3. Select the **DELETE . .** menu.



Confirmation for delete will be requested. Push control knob to confirm. Waypoint will be deleted from current flight plan.

See **ACTV (Active) Options**, page 4-10 for more information.

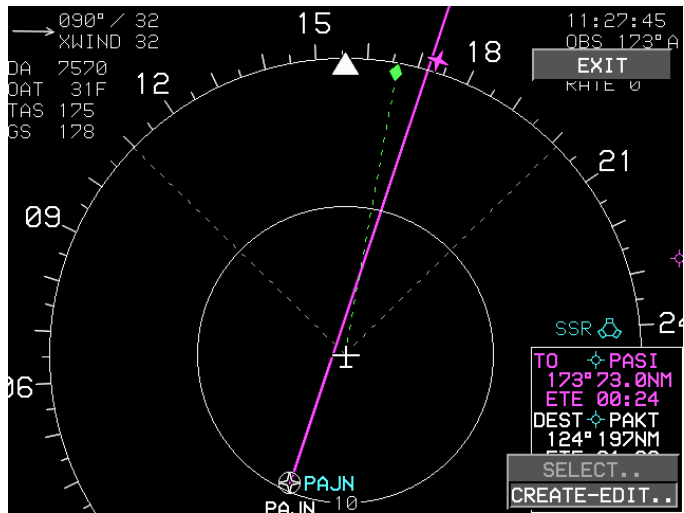
Create a User Waypoint

User waypoints may be created in three ways:

- A. Latitude & Longitude**
- B. Radial & Distance**
- C. Overfly (Designate)**

A. To create a user waypoint using Latitude & Longitude:

1. Press the **FPL** button.
2. Turn control knob to highlight **CREATE - EDIT . . .**, then push to enter.



3. Turn control knob to highlight **CREATE USER WPT (LAT-LON)**, in the Function Select screen, then push to enter.



Using the control knob to enter alphanumeric characters, follow on-screen prompts to edit information.



- a) **Identifier:** The top line allows the user to specify a five

character identifier for the waypoint

b) Latitude: The second line allows the user to specify latitude for the waypoint in increments of hundredths of minutes.

c) Longitude: The third line allows the user to specify a longitude for the waypoint in increments of hundredths of minutes.

d) Elevation: The fourth line allows the user to specify an elevation for the waypoint in feet. (This value may be used for VFR approaches.)

e) Approach Bearing: The fifth line allows the user to specify an approach bearing to the user waypoint in degrees. Valid values are 1°-360° and “OFF.” A value of “OFF” will disable VFR approaches to the user waypoint. (This value may be used for defining user waypoint VFR approaches.)

f) Magnetic Variation: The sixth line allows the user to specify a magnetic variation at the waypoint in tenths of a degree.

After all fields have been entered, push the control knob to save and return to the editing screen.

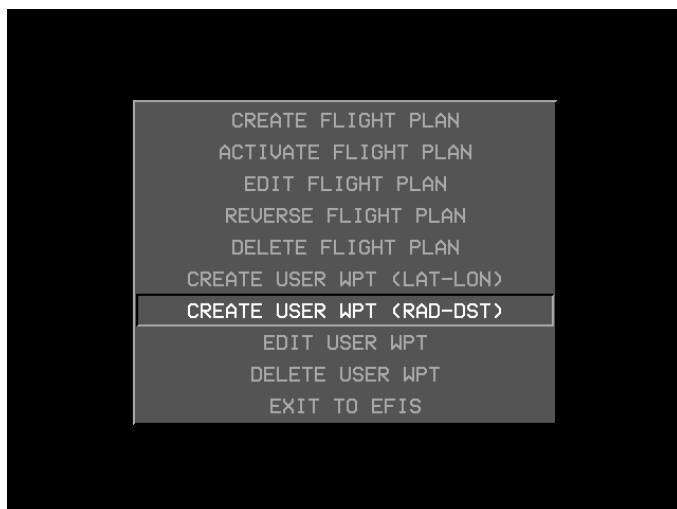
B. To create a user waypoint using Radial & Distance:

1. Press the **FPL** button.

- Turn control knob to highlight **CREATE - EDIT . .**, then push to enter.



- Turn control knob to highlight **CREATE USER WPT (RAD-DST)**, then push to enter. This will display the editing screen:.



4. Using control knob to enter alphanumeric characters, follow on-screen prompts to edit information.



The radial-distance user waypoint creation screen allows the user to create a waypoint by reference to radial and distance from another waypoint.

The screen has various data entry boxes as follows:

a) Identifier: The first line will annunciate the automatic name applied to the new user waypoint. New user waypoint will automatically be named “RD###,” where ### is the next available radial-distance waypoint number.

b) Reference Waypoint: The second line will be prompted to enter an identifier for the reference waypoint. The reference waypoint will be entered in the same manner as a waypoint is entered for a flight plan using the control knob. If there is a single result from the search, the user will be advanced to the radial entry box. If there is no result from the search, the user will be re-prompted to enter an identifier. If there are multiple results from the search, a selection list with matching identifiers will be displayed and, upon selection, the user will be advanced to the radial entry box. An **INFO** menu giving access to information for the highlighted result will appear at this level to aid in selection.

c) **Radial Entry:** The third line will allow the user to specify a radial from the reference waypoint in increments of degrees.

d) **Distance Entry:** The forth line will allow the user to specify a distance from the reference in increments of tenths of nautical miles.

After all fields have been entered, push the control knob to save and return to the editing screen.

C. To create an Overfly user waypoint:

When directly over the intended waypoint, press **MENU** then **DESIG**.

A user waypoint will be created at the present position and automatically be named “OF###” where ### is the next available overfly user waypoint number.

The waypoint name may be changed using the **EDIT USER WPT** function, see **Edit a User Waypoint, page 5-35**.

NOTE:

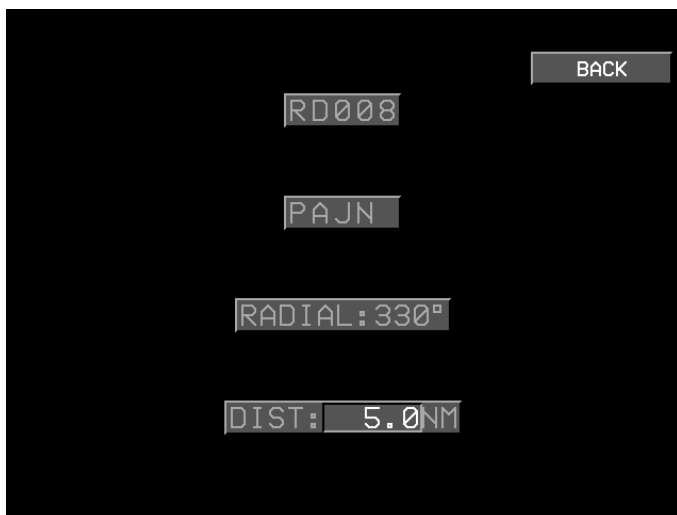
A maximum of 500 user waypoints may be created and stored.

Edit a User Waypoint

1. Press the **FPL** button.
2. Turn control knob to highlight **CREATE - EDIT . . .**, then push to enter.
3. Turn control knob to highlight **EDIT USER WPT**, then push to enter.



4. Turn control knob to highlight user waypoint to be edited, then push to enter.



5. Using the control knob to enter alphanumeric characters, follow on-screen prompts to edit information. Step through the characters by pushing the control knob. Back up by pressing **BACK**.

Delete a User Waypoint

1. Press the **FPL** button.
2. Turn control knob to highlight **CREATE - EDIT . . .**, then push to enter.

3. Turn control knob to highlight **DELETE USER WPT**, then push to enter.



4. Turn control knob to highlight user waypoint to be deleted, then push to enter. The selected user waypoint will be deleted from the system.

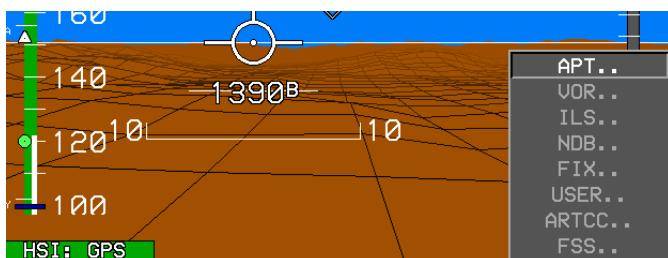
Waypoint Information (NavData)

A large amount of information regarding each waypoint can be retrieved such as lat/lon, bearing/distance, elevation or altitude, nav and com frequencies, and runway lengths.

This information can be accessed in a variety of ways (from the active route using **ACTV** or for nearby waypoints using **NRST** and then pressing the **INFO** button).

Nearby Waypoints

1. Press the **NRST** button.



2. Turn control knob to highlight Airport, VOR, ILS, NDB, fix, user waypoint, air traffic control center, or Flight Service Station as desired then push to enter.
3. Turn control knob to highlight desired waypoint or facility and press the **INFO** button.
4. Turn the control knob to scroll through the information.
5. Push the control knob or press **BACK** to return to the **ACTV** menu or press **EXIT** to clear the screen.

Distant Waypoints not in Active Route

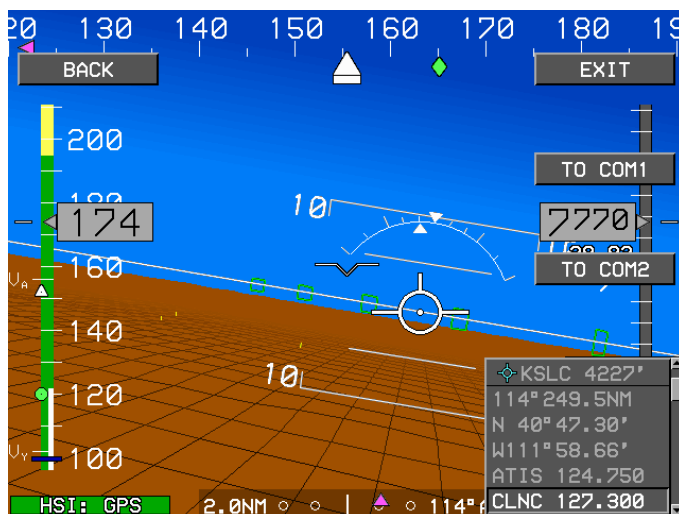
1. Press the **INFO** button and use the control knob to enter the alphanumeric identifier.
2. Turn the control knob to scroll through the information.
3. Push the control knob or press **BACK** to return to the **ACTV** menu or press **EXIT** to clear the screen.

Waypoints within Active Route

1. Press the **ACTV** button.



2. Turn control knob to highlight the desired waypoint, then press the **INFO** button.



3. Turn the control knob to scroll through the information. If a frequency is displayed in this step, it may be highlighted and sent to a radio. See **Tuning Radios using the EFIS**, page 5-89 for more information.
4. Push the control knob or press **BACK** to return to the **ACTV** menu or press **EXIT** to clear the screen.

Transfer User Waypoints Between Aircraft

There may be times when it is necessary to transfer user waypoints created on one system to a system in another aircraft. This is done using the Ground and Maintenance Utility.

1. With the power **OFF**, insert a data card into the primary flight display (gold side up).
2. Power the system ON and select the **DOWNLOAD ROUTES AND USER WAYPOINTS** option using the control knob (turn to scroll, push to enter).

```
Chelton Flight Systems Ground and Maintenance Functions:

Run Demonstrator/Training Program
Update Databases, Limits and Application
Download Log Files
Fuel Tank Calibration (CPU#0 or CPU#1 Only)
View Fuel Tank Calibration Map (CPU#0 or CPU#1 Only)
View bitlog.dat
L3 WX-500 Maintenance Utility (CPU#0 or CPU#1 Only)
Ryan TCAD Maintenance Utility (CPU#0 or CPU#1 Only)
Terrain Data Verification
Display Internal Temperature
Download Routes and User Waypoints
Upload Routes and User Waypoints
View System Limits (CPU#0 or CPU#1 Only)
```

3. Power the system **OFF** and remove the data card
4. With the power **OFF**, insert a data card into the primary flight display in the other aircraft (gold side up).

5. Power the system **ON** and select the **UPLOAD ROUTES AND USER WAYPOINTS** option using the control knob (turn to scroll, push to enter).

```
Chelton Flight Systems Ground and Maintenance Functions:
```

```
Run Demonstrator/Training Program
Update Databases, Limits and Application
Download Log Files
Fuel Tank Calibration (CPU#0 or CPU#1 Only)
View Fuel Tank Calibration Map (CPU#0 or CPU#1 Only)
View bitlog.dat
L3 WX-500 Maintenance Utility (CPU#0 or CPU#1 Only)
Ryan TCAD Maintenance Utility (CPU#0 or CPU#1 Only)
Terrain Data Verification
Display Internal Temperature
Download Routes and User Waypoints
Upload Routes and User Waypoints
View System Limits (CPU#0 or CPU#1 Only)
```

6. Power the system **OFF** and remove the data card

NOTE:

The system cannot enter flight mode while the data card is in the slot.

Using Airways (Victor/Jet Routes)

Airways, including low-altitude Victor Airways and high-altitude Jet Routes, are extremely easy to enter into the EFIS and can be included in a stored flight plan or added to an active flight plan or route “on the fly.”

To enter an airway into a route, it must be preceded with a fix (VOR, intersection) that is located on the airway (an airway cannot be added between the START waypoint and the next waypoint, for example).

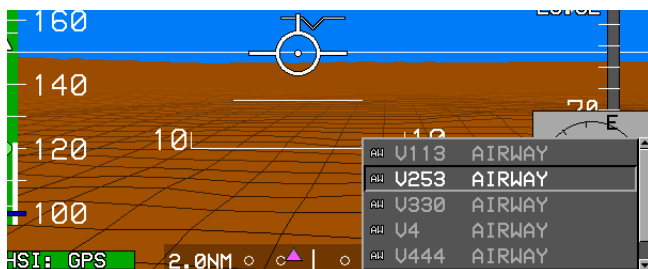
Airways are identified using their name (**V113**, **J254**) and are entered into the system in the same format in which they are received from controllers or in a clearance. They may be entered using their full name but only the **V** or the **J** must be entered (in which case a list will be presented).

For example, on a flight from Boise, where there is a VOR on the field, to Salt Lake City, the following clearance is received:

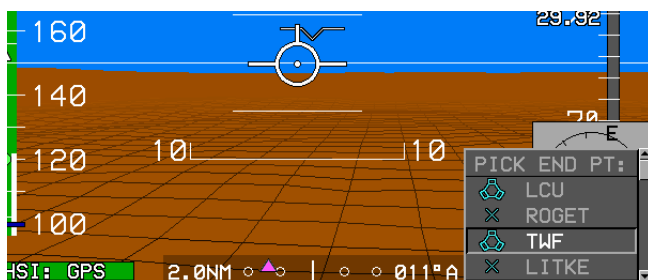
“ATC clears N1234 to Salt Lake City via radar vectors to join V253 to Twin Falls, V142 to SHEAR, V101 to Ogden, direct.”

1. Using the **NRST** button, choose **BOI** (the Boise VOR -- the nearest fix on V253. Remember, airways must be preceded by an airway fix).
2. Press **ACTV**, scroll to the blank space after **BOI**, press **ADD . .** or **INSERT . .** and enter **V253**. You may also just enter a **V** in the first box and advance through the remaining boxes, leaving them empty; a list of all Victor Airways passing through BOI will be shown.

3. Scroll to select the desired airway, **V253** in this case, and push to enter.



A list of fixes along the airway will be shown.



4. Scroll up or down (Jeppesen determines the order) to the desired end point on that airway (Twin Falls -- **TWF**) and push to enter.
5. Repeat steps 3 and 4 for each leg until you reach Ogden VOR as an end point for V101.
6. Repeat the procedure again and enter **KSLC** for Salt Lake City instead of an airway.

The same procedure is used for Jet routes by substituting a **J** for the **V**.

All of the appropriate fixes along the airway will be added to the route. Review the entire route by pressing the **ACTV** button.

Approaches, DPs, and STARs

Select a VFR Approach

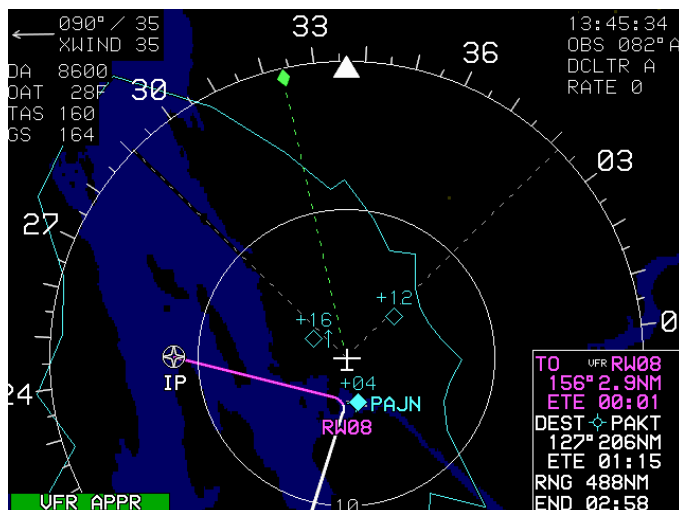
1. Press the **ACTV** button.
A list of waypoints in the current flight plan will be displayed.
2. Turn control knob to highlight landing airport or user waypoint, then push to enter.
3. Turn control knob to highlight **VFR APPR . .** and push to enter.



A list of runways at the destination airport will be displayed (no runways are displayed for user waypoints).



4. Turn control knob to highlight desired runway and push to enter. The VFR approach will be entered and displayed as a courseline on the moving map.



The VFR Skyway approach symbology will be displayed on the PFD. The skyway boxes will guide the pilot to an extended centerline for the chosen runway.

An initial point (labeled IP, followed by the runway number) will be automatically created. It will be placed 15NM from the runway and it will be preceded by a discontinuity. If a more direct approach is desired, change the active waypoint to the destination airport. Skyway boxes will then lead directly to the center of the airport.



WARNING!

THE VFR APPROACH FUNCTION DOES NOT PROVIDE TERRAIN OR OBSTRUCTION CLEARANCE. EXTREME CARE SHOULD BE TAKEN WHEN USING THE VFR APPROACH FUNCTION AT NIGHT OR IN MARGINAL VFR CONDITIONS.

***AUDIBLE ANNUNCIATION***

The TERMINAL flag will be displayed when within 30NM of the airport and will be accompanied by an auditory chime.

TERMINAL

VFR APPR flag will be displayed along with an auditory chime when established on the final approach course.

VFR APPR

Select an IFR Approach

1. Press the **ACTV** button.
A list of waypoints in the current flight plan will be displayed.
2. Turn control knob to highlight landing airport, then push to enter.
3. Turn control knob to highlight **IFR APPR . .** and push to enter. A list of the published instrument approaches will be displayed.



4. Turn control knob to highlight desired approach and push to enter. A list of available transitions will be displayed if applicable.



5. Turn control knob to highlight desired transition and push to enter. A list of runways will be displayed.



- Turn control knob to highlight desired runway and push to enter.

The approach will be entered and displayed as a white courseline on the moving map, except the active leg, which will be magenta.

The approach waypoints will be displayed on the PFD and automatically sequenced so that only the active waypoint is shown (magenta).



A crossing altitude for each waypoint will be displayed in the waypoint information box (lower right corner of PFD) and the target altitude will automatically be updated.

Minimum descent altitude or decision height can be entered by setting **MIN ALT . .** from the **BUGS . .** menu. The CDI scale will gradually adjust according to the phase of flight and will be indicating 0.3 nautical miles when 2 nautical miles from the final approach fix. Inside the final approach fix, the CDI will be angular like a localizer.

***AUDIBLE ANNUNCIATION***

The TERMINAL flag will be displayed when within 30NM of the airport and will be accompanied by an auditory chime.

TERMINAL

VFR APPR flag will be displayed along with an auditory chime when established on the final approach course.

IFR APPR

Select a DP or STAR

Selecting a DP or STAR involves essentially the same steps, just substitute **STAR** for **DP** in the following instructions.

1. Press the **ACTV** button.
A list of waypoints in the current flight plan will be displayed.
2. Turn control knob to highlight appropriate airport, then push to enter.
3. Turn control knob to highlight **SELECT . .**, then push to enter
4. Turn control knob to highlight **DP . .** and push to enter. A list of published procedures will be displayed.



5. Turn control knob to highlight desired procedure and push to enter. A list of available transitions will be displayed if applicable.



6. Turn control knob to highlight desired transition and push to enter. A list of runways will be displayed.



7. Turn control knob to highlight appropriate runway and push to enter. The DP will be entered and displayed as a white courseline on the moving map, except the active leg, which will be magenta.



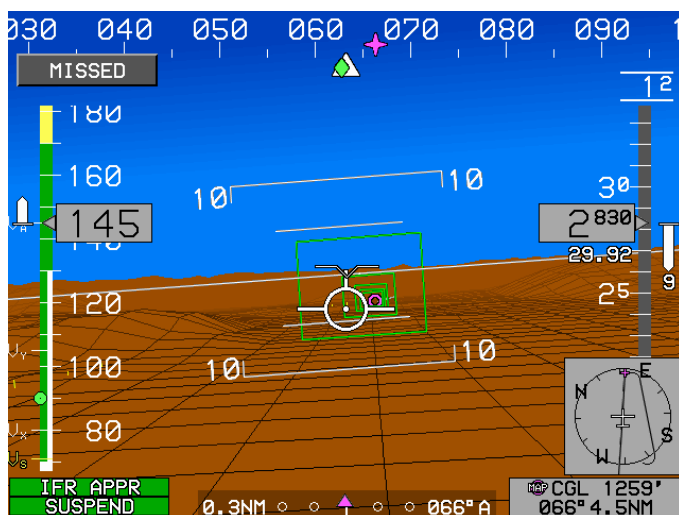
The approach waypoints will be displayed on the PFD and automatically sequenced so that **only** the active waypoint is shown (magenta).



A crossing altitude for each waypoint will be displayed in the waypoint information box (lower right corner) and automatically entered as the target altitude.

Missed Approach Arming Procedure

1. The **MISSED** menu tile will be displayed automatically upon passing the final approach fix (FAF) of a published instrument approach.
2. To arm the missed approach procedure, press the **MISSED** menu any time. The missed approach procedure will be automatically activated upon passing the missed approach point (MAP).



The appropriate missed approach procedure is always displayed as a white dashed courseline on the moving map, except the active leg (when appropriate), which will be magenta.

After passing the MAP, the missed-approach procedure waypoints will be displayed on the PFD and automatically sequenced so that **only** the active waypoint is shown (magenta hoop).

If the **MISSED** menu is *not* pressed after FAF passage, navigation guidance will continue along the extended centerline of the runway and automatic waypoint

sequencing will be suspended (indicated by a SUSPEND flag; the missed approach procedure can be activated at any time.

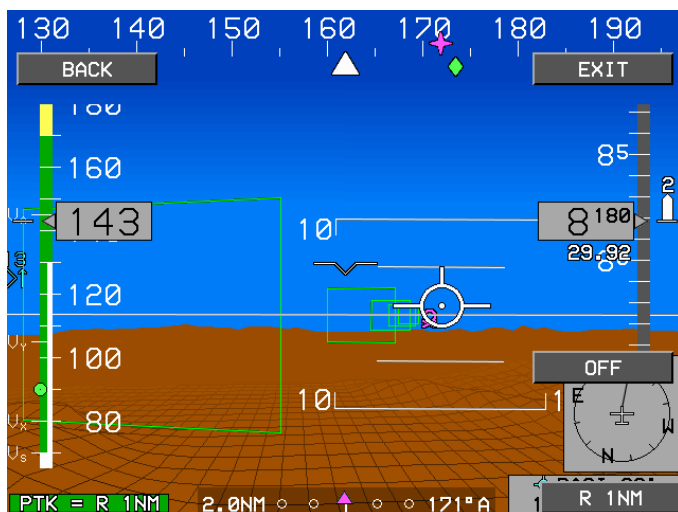
The missed approach procedure can be activated prior to the final approach fix by selecting the first waypoint of the missed procedure from the **ACTV** menu, see **Activate a Waypoint within an Active Route**, page 5-23.

Set a Parallel Track

1. Press the **ACTV** button.
2. Select the **PTK . .** menu.



3. Turn control knob left or right to select offset distance in one NM increments, then push to enter.



Waypoints will automatically be sequenced as the flight progresses.



AUDIBLE ANNUNCIATION

The parallel track function will be annunciated by a green advisory flag indicating the direction (left or right) and the distance (NM) of offset and will be accompanied by an auditory chime.

PTK = (L)RXXNM

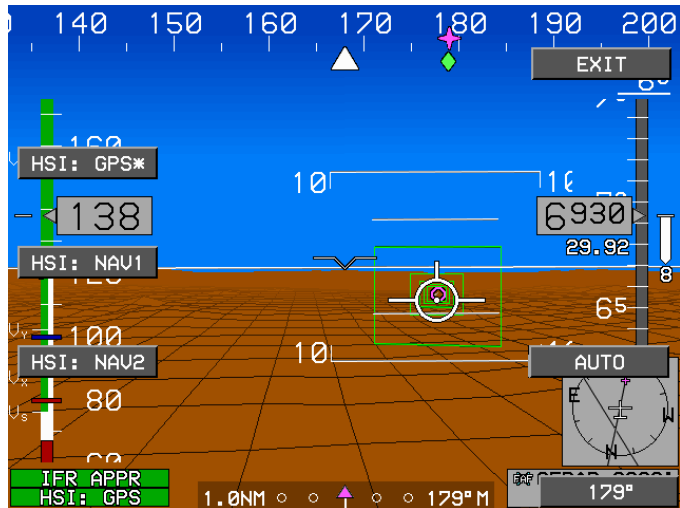
Turn Parallel Track Off

1. Press the **ACTV** button.
2. Select the **PTK . .** menu.
3. Select the **OFF** menu.

Omnibearing Selector Function

Automatic OBS -- GPS

1. Press the **OBS** button.
2. Choose HSI: GPS and press **AUTO**.



3. The OBS setting will automatically adjust to reflect the current flight plan segment.

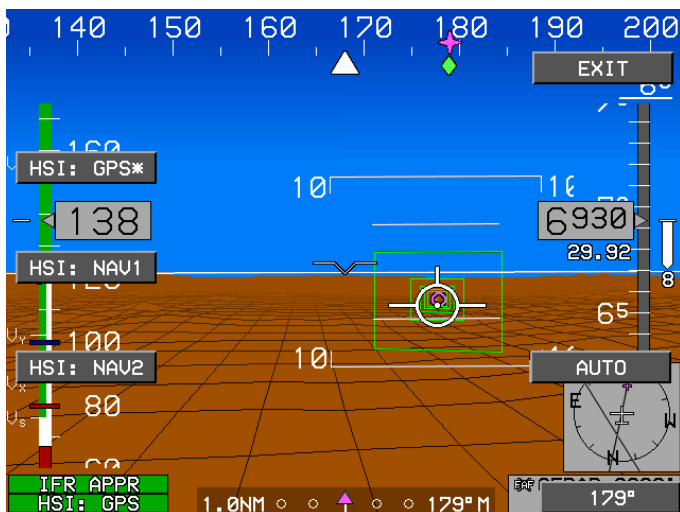
Waypoints will automatically be sequenced as the flight progresses.

NOTE:

Automatic OBS is the system default.

Manual OBS -- GPS

1. Press the **OBS** button.
2. If it is not already selected, push **HSI: GPS**, then turn the control knob to set desired OBS course, then push to enter.

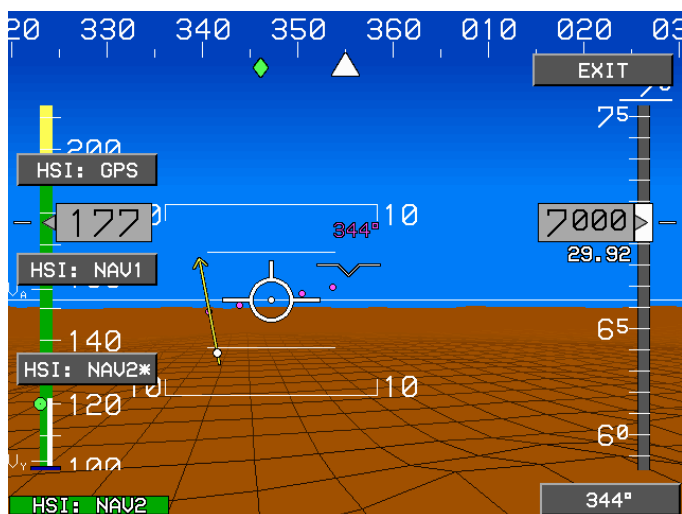


The OBS courseline will be displayed through the active

VOR OBS -- HSI

When interfaced with a VHF nav radio, this will set the OBS course of the selected VOR (Nav 1 or Nav 2, see **HSI Source Selection, page 5-63**). VOR course information is displayed on either the PFD or on the ND as a conventional HSI. To display HSI on PFD, use the **DCLTR . .** function.

1. Press the **OBS** button.
2. Turn control knob to select desired OBS course, then push to enter.



Selected course is shown above and to the right of the flight path marker. A white dot on the HSI needle provides TO/FROM indication. At full-scale deflection, the courseline arrow will be yellow as shown above. The deviation dots are automatically decluttered when needle deflection is less than one dot.

The selected HSI source (Nav 1 or Nav 2) will drive the autopilot when it is placed in NAV or APPROACH mode.

HSI Source Selection

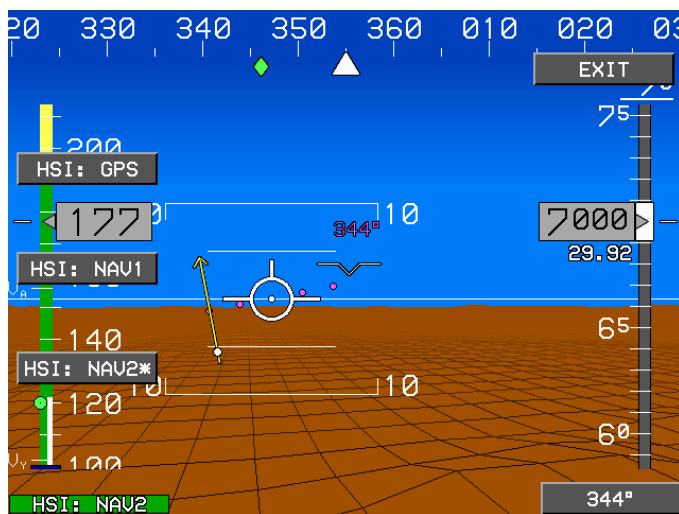
The source of the HSI that is displayed on the PFD or ND can be set to GPS, Nav 1, or Nav 2. The selected source will be annunciated with a green flag in the lower left corner of the display.

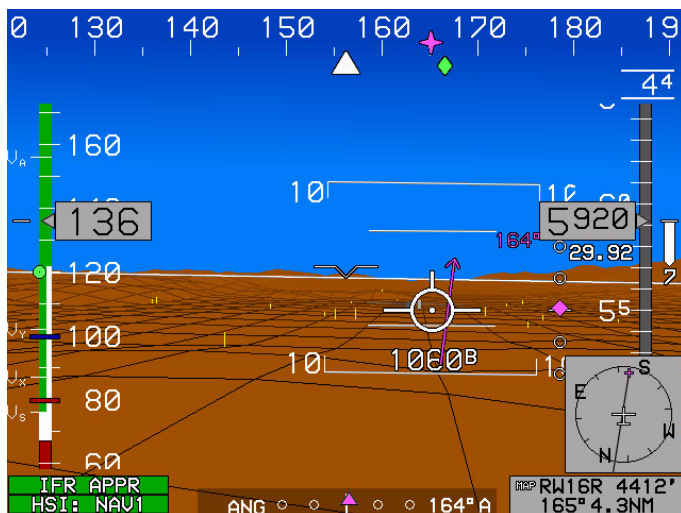
The HSI on the PFD may be turned on and off using the **Declutter** function and will only be shown if there is a valid VOR nav signal. If the EFIS detects a localizer and glideslope, the HSI on the PFD will automatically be replaced with the ILS needles, see **Localizer/Glideslope (ILS)**, page 3-35.

The MFD can be configured to show a conventional HSI using the **DISP . .** menu.

To choose the HSI source:

1. Press the OBS button.
2. Press the button adjacent to the desired HSI source. An asterisk indicates the source selected.





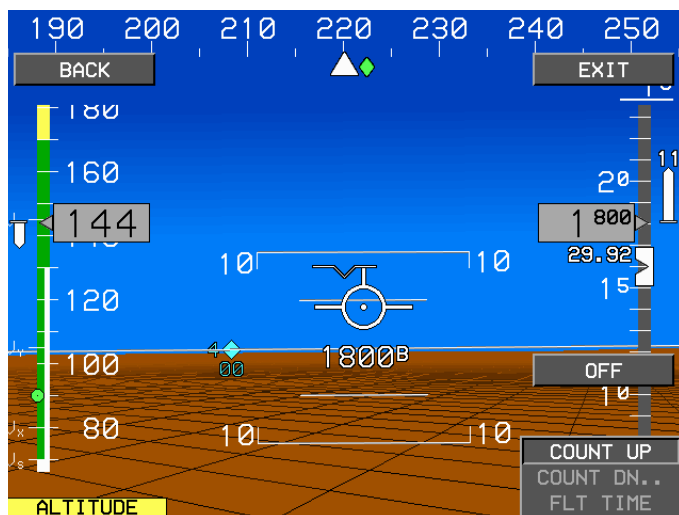
NOTE:

The skyway on the PFD and magenta courseline on the moving map are always GPS-based. The HSI (both PFD and ND) can be GPS- or VOR-based. The selected HSI source also determines the analog course and deviation signals sent from the EFIS to the autopilot (HSI source does not affect GPS roll steering or analog heading signals sent to the autopilot). This allows you to fly a coupled ILS and still see both the ILS and the skyway on the PFD.

Timer Functions

Count Up

1. Press the **MENU** button.
2. Select the **TIMER . .** menu
3. Turn control knob to highlight **COUNT UP**, then push to enter.



A count-up timer will be centered above the flight path marker on the PFD and below the zulu clock on the moving map.

Count Down

1. Press the **MENU** button.
2. Select the **TIMER . .** menu
3. Turn control knob to highlight **COUNT DN . .**, then push to enter.



4. Enter the desired time period by turning the control knob to select numeric character and pushing to enter and advance to the next character (press **BACK** at any point to back up). Press **+5 MIN** or **-5 MIN** to quickly add or subtract time in five-minute increments.

The count-down time can be stored for later use by pressing **STORE**. Once stored, this value will be the default for the count down timer.

A count-down timer will be centered above the flight path marker on the PFD and below the zulu clock on the moving map.

Flight Timer

1. Press the **MENU** button.
2. Select the **TIMER . .** menu. Press to enter.

The flight time since takeoff will be displayed in the bottom right corner of the primary flight display for 10 seconds or until another button is pushed.

Turn the Timer Off

(Count up and count down timers only)

1. Press the **MENU** button.
2. Select the **TIMER . .** menu.
3. Press the **OFF** menu button.

BUG Functions (Heading, Altitudes, Airspeed, V-Speeds)

Set the Heading Bug

1. Press the **HDG** button.
2. Turn control knob to select the desired heading and push. Heading selection is in 1° increments and the number will change faster if you turn the control knob faster.

Press **SYNC** to instantly set the heading bug on the current heading.

If coupled with an autopilot in **HEADING** mode, the EFIS will command the autopilot to maintain the selected heading. If the autopilot is flying a flight plan, invoking the heading bug will override the flight plan course in favor of the selected heading.

Turn Heading Bug Off

1. Press the **HDG** button.
2. Press the **OFF** menu button.

If coupled with an autopilot in **HEADING** mode, turning the heading bug off will result in the autopilot reintercepting the active leg of the route, if one is selected.

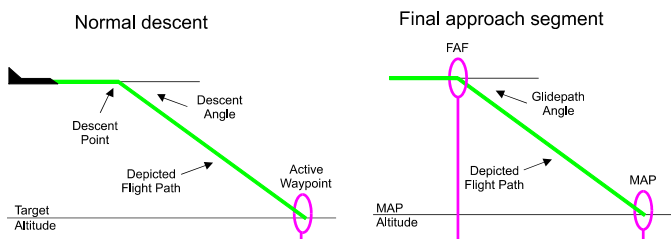
Specify a Target Altitude

1. Press the **MENU** button while on the PFD display page.
2. Press the **BUGS . .** menu.
3. **TGT ALT . .** will be highlighted, push to enter.
Current altitude, rounded to the nearest 10 foot increment in the approach phase and nearest 100 foot increment in the enroute and terminal areas will be displayed.
4. Turn control knob to select the desired target altitude and push to enter.
A bow-tie shaped bug will be located on the altimeter tape, centered on the target altitude.

Press **SYNC** to instantly set the target altitude to the current altitude.

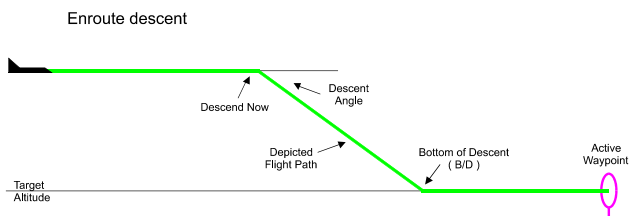
The target altitude value will be displayed between two horizontal white bars immediately above the altimeter tape.

If a lower target altitude is selected, the skyway will maintain the current altitude until the preprogrammed VNAV descent angle will take the aircraft over the next waypoint at the target altitude:

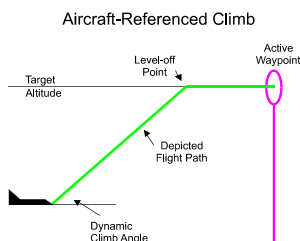


For enroute descents or to comply with a crossing restriction, set a target altitude then press **DCND NOW**. The skyway will descend immediately to the target altitude and a **B/D** will be

shown on the moving map to indicate the location of the bottom-of-descent point.



If a higher target altitude is selected, the skyway will immediately climb to the target altitude at the preprogrammed VNAV climb angle and level off:



If the aircraft reaches the target altitude before the skyway does, the skyway will automatically reset at the target altitude.



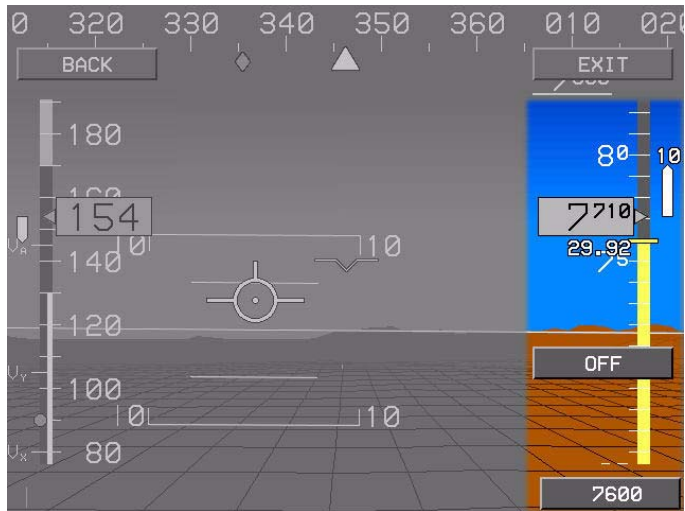
AUDIBLE ANNUNCIATION

Deviation more than 150 feet from target altitude will result in an yellow caution flag and a single voice warning of "Altitude. Altitude."

ALTITUDE

Specify a Minimum Altitude

1. Press the **MENU** button while on the PFD display page.
2. Select the **BUGS . .** menu.
3. Turn control knob to highlight **MIN ALT . .**, then push to enter.
Current altitude, rounded to the nearest 10 foot increment, will be displayed.
4. Turn control knob to select desired minimum altitude and push to enter.



The altimeter tape will be displayed in yellow below the minimum altitude. The minimum altitude value will be displayed above a single horizontal white bar immediately above the yellow altimeter tape.



AUDIBLE ANNUNCIATION

Descending below the minimum altitude will result in a yellow caution flag and an annunciation of “Altitude.”

ALTITUDE

Specify a Target Airspeed

1. Press the **MENU** button while on the PFD display page.
2. Select the **BUGS . .** menu.
3. Turn control knob to highlight **SPD SEL . .**, then push to enter.
Current airspeed will be displayed.
4. Turn control knob to select desired target airspeed and push to enter.

Press **SYNC** to instantly set the airspeed bug on the current airspeed.

A bow-tie shaped bug will be located on the airspeed tape, centered on the target airspeed.
Selected airspeed value will be displayed immediately above the airspeed tape.



AUDIBLE ANNUNCIATION

Deviating from the selected airspeed by 10 knots will result in an yellow caution flag and an auditory chime.

AIRSPEED

Turn Bugs Off

1. Press the **MENU** button while on the PFD display page.
2. Select the **BUGS . .** menu.
3. Turn control knob to highlight **TGT ALT . .**, **MIN ALT . .**, **SPD SEL . .** then push to enter.
4. Press the **OFF** menu button.

Set V-Speeds

1. Press the **MENU** button while on the PFD display page.
2. Select the **BUGS . .** menu.
3. Turn control knob to highlight **V-SPDS . .** then push to enter and choose **TAKEOFF . .** or **APPROACH . .**
4. Turn control knob to highlight the desired speed (**V1 . .**, **VR . .**, **V2 . .**, **VREF . .**, **VAPP . .**, or **VENR . .**) and use the control knob to set the speed. Push to enter.

To minimize clutter, V_1 , V_R , and V_2 are reset to zero at each power cycle and are disabled when exceeded by 40 KIAS or when the aircraft climbs above 2,000 ft. AGL.

Vertical Navigation (VNAV)

The FlightLogic EFIS provides advanced yet intuitive vertical navigation capability known as VNAV. The skyway provides VNAV guidance for all procedures including including DPs, STARs, approaches, and missed approaches. The EFIS also supports enroute or expedited descents, ATC-assigned crossing restrictions, top- and bottom-of-descent cues, and an altitude capture predictor.

All VNAV functions are based on climb and descent angles which, except for descents in approaches, are set by the pilot using the VNAV CDA (climb/descent angles).

During approaches, the descent angles are derived from the Jeppesen NavData.

Change VNAV Angles

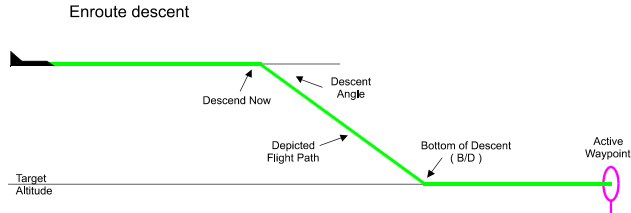
1. Press the **MENU** button on the PFD.
2. Select the **BUGS . .** menu.
3. Turn control knob to highlight **VNAV CDA . .** then push to enter.
4. Turn control knob to highlight **CLIMB ANG . .** or **DESC ANG . .** and push to enter.

Using the control knob, turn to select the desired climb or descent angle value and push to enter. To cancel, push **EXIT**.

Enroute Descents

Enroute or expedited descents are accomplished by setting a target altitude for the active waypoint, then choosing **DCND NOW** (descend now). This causes the skyway to begin

the descent immediately rather than waiting until a normal descent will cross the active waypoint at the target altitude.



1. Press the **MENU** button on the PFD then select the **BUGS . .** menu.
2. Turn control knob to highlight **TGT ALT . .** then push to enter.
3. Turn control knob to set a target altitude and push to enter.
4. Now, or at a later time, select the **DCND NOW** menu.

VNAV Planning

When a target altitude is specified, the altitude capture predictor (a green arc ahead of the aircraft) is shown on the moving map. The symbol indicates the point on the map where the skyway will reach the target altitude, based on the VNAV CDA settings. In a climb, it marks the top of the climb. In a descent, it marks the bottom of the descent. Use the altitude capture predictor to plan climbs and descents.



For example, if you wish to cross a desired point on the map (a fix, airspace, terrain feature, etc.) at a specific altitude, start your climb or descent when the altitude capture predictor is on the desired point.

For Climbs:

1. Press the **MENU** button on the PFD and select the **BUGS . .** menu.
2. Turn control knob to highlight **TGT ALT . .** then push to enter.
3. Turn the control knob to set the desired altitude and push to enter.

The skyway will immediately indicate a climb and the altitude capture predictor will indicate the point on the map where the skyway will reach the target altitude.

For Descents:

1. Press the **MENU** button on the PFD and select the **BUGS . .** menu.
2. Turn control knob to highlight **TGT ALT . .** then push to enter.
3. Turn the control knob to set the desired altitude and push to enter.
4. When the altitude capture predictor on the moving map reaches the point at which you wish to reach the target altitude, select **DCND NOW** on the PFD (see **Enroute Descents**, page 5-74).

The skyway will immediately indicate a descent and the altitude capture predictor will indicate the point on the map where the skyway will reach the target altitude.

The bottom-of-descent point will be added to the route as a waypoint named **B/D**.

Controlling The Displays

Change MFD Display Pages

Push the control knob to advance to the next display. The order is PFD followed by the Navigation Display, the engine page (if equipped), then back to the PFD.

Show/Hide Terrain (Moving Map)

1. Press the **MENU** button.
2. Select the **FORMAT . .** menu.
3. Turn control knob to select the **FNCT DCLTR . .** and push to enter.
4. Turn the control knob to select **TERRAIN**.
5. Push control knob to turn terrain on or off (a check mark indicates terrain ON). Select **DONE** and push to enter when finished.

NOTE:

Terrain and obstructions are controlled simultaneously. If hidden, terrain and obstructions will turn on automatically if a threat is detected.

Show/Hide LAT/LON (Moving Map)

Current latitude and longitude can be shown on the navigation display.

1. Press the **MENU** button.
2. Select the **FORMAT . .** menu.
3. Turn control knob to select the **FNCT DCLTR . .** and push to enter.
4. Turn the control knob to select **LAT/LON**.
5. Push control knob to turn LAT/LON on or off (a check mark indicates terrain ON). Select **DONE** and push to enter when finished.

Show/Hide RMI/ADF (Moving Map)

A dual RMI and ADF can be overlaid on the moving map.

1. Press the **MENU** button.
2. Select the **FORMAT . .** menu.
3. Turn control knob to select the **FNCT DCLTR . .** and push to enter.
4. Turn the control knob to select **RMI**.
5. Push control knob to turn RMI/ADF on or off (a check mark indicates terrain ON). Select **DONE** and push to enter when finished.

NOTE:

This option is only available with the optional nav interface. RMI/ADF will only be shown if a valid nav signal is present.

Show/Hide RMI/ADF (HSI)

A dual RMI and ADF can be displayed on the conventional HSI.

1. Press the **MENU** button.
2. Select **RMI ON** or **RMI OFF** as appropriate.

Show/Hide Strikes (Moving Map)

1. Press the **MENU** button.
2. Select the **FORMAT . .** menu.
3. Turn control knob to select the **FNCT DCLTR . .** and push to enter.
4. Turn the control knob to select **STRIKES**.
5. Push control knob to turn STRIKES on or off (a check mark indicates terrain ON). Select **DONE** and push to enter when finished.

Scale the Moving Map

Turn the control knob clockwise to increase scale and counterclockwise to decrease scale. Map scales available are 1, 2, 5, 10, 20, 50, 100, 200, and 400 nautical miles.

Change Moving Map Format

The Navigation Display can be viewed in a variety of formats including position-centered (full compass rose), arc (position offset), heading up, and north up.

Centered or Arc Format

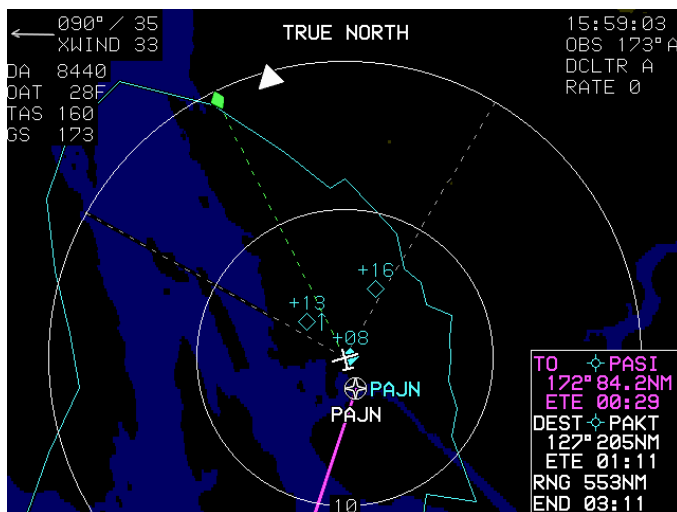
1. Press the **MENU** button.
2. Select the **FORMAT . .** menu.
3. Turn control knob to highlight **CENTER** or **ARC**, then push to enter.



The dedicated traffic display can only be shown in centered mode.

Heading-Up or North-Up Format

1. Press the **MENU** button.
2. Select the **FORMAT . .** menu.
3. Turn control knob to highlight **HDG UP** or **N UP**, then push to enter.



Change Moving Map Function

In addition to the moving map, the MFD can display an HSI, a dedicated lightning display, and a dedicated traffic display.

1. Press the **MENU** button.
2. Select the **DISPLAY . .** menu.
3. Turn control knob to highlight desired function, (MAP, HSI, STRIKES, or TRAFFIC) then push to enter.

Declutter the Moving Map

The moving map can be decluttered in two ways: removing navigation symbology, and removing display functions (i.e. terrain, traffic, lightning).

Manual Declutter Navigation Symbology:

1. Press the **MENU** button.
2. Select the **FORMAT . .** menu.
3. Turn control knob to highlight **SYMB DCLTR . .**, then push to enter.
4. Select **MANUAL . . .** Auto settings are optimized factory defaults.
5. Turn control knob to highlight desired elements and push to enable or disable. A check mark after an element indicates ON.
6. Turn the control knob to select **DONE** and push to enter.

Declutter Display Functions

1. Press the **MENU** button.
2. Select the **FORMAT . .** menu.
3. Turn control knob to highlight **FNCT DCLTR . .**, then push to enter.
4. Turn control knob to highlight functions and push to enable or disable. A check mark after a function indicates ON.
5. Turn the control knob to select **DONE** and push to enter. Declutter settings are saved upon system shutdown.

Auto Declutter Navigation Symbology

To set the system for automatic decluttering:

1. Press the **MENU** button.
2. Select the **FORMAT . .** menu.
3. Turn control knob to highlight **SYMB DCLTR . .**, then push to enter.
4. Turn control knob to highlight **AUTO**, then push to enter.

Declutter The PFD

1. Press the **MENU** button.
2. Select the **DCLTR . .** menu. A menu containing Bank Scale, Mini Map, Skyway, Terrain, Traffic, HSI, and conventional autopilot FD (flight director) will be displayed.



3. Turn control knob to highlight elements and push to enable or disable elements. A check mark indicates enabled.

Select **DONE** when you are finished. Declutter settings will be saved upon system shutdown.

NOTE:

The HSI and flight director are mutually exclusive.

Zoom the PFD

The PFD can be set to two different fields of view: 35° and 70°.

The 70° field of view is the default and resembles a wide-angle lens on a camera. Since aircraft operate primarily in the lateral plane, this field of view is most useful.

However, if you want to see terrain displayed so that it more closely resembles what you see out the window, select the zoom (35° field of view). This magnified view more closely matches the human eye and will give a very realistic depiction of terrain but since the heading and pitch scales are magnified as well, the display will be very sensitive to every movement of the aircraft.

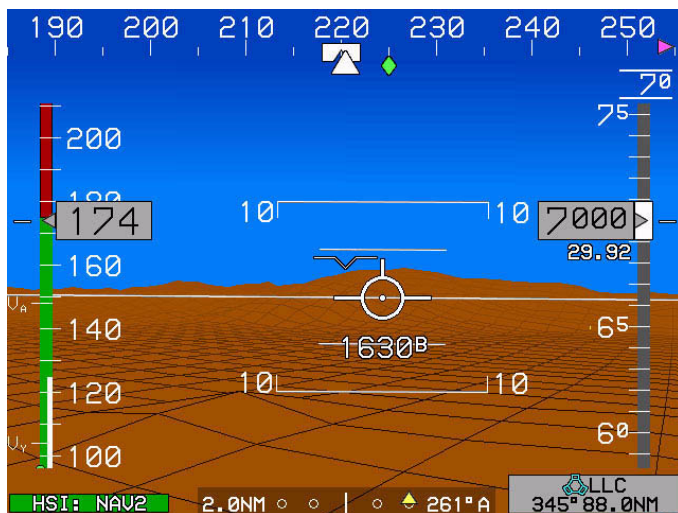
To set the zoom mode:

1. Press the **MENU** button.
2. Select the **ZOOM ON** or **ZOOM OFF** menu.

NOTE:

Field of view is indicated on the moving map by two dashed lines that form a “pie” shape extending forward from the aircraft. Only objects within the pie shape on the moving map will appear on the PFD.

Zoom OFF (70° field of view)



Zoom ON (35° field of view)



Controlling the Stormscope Display

These procedures refer only to the dedicated WX-500 Stormscope display function and are available only when a WX-500 Stormscope is connected to the system.

Centered or Arc Format

1. Press the **MENU** button.
2. Select the **FORMAT . .** menu.
3. Turn control knob to highlight **CENTER** or **ARC**, then push to enter.

Route On or Route Off

To show or hide the active route while in the dedicated Stormscope display function:

1. Press the **MENU** button.
2. Select the **FORMAT . .** menu.
3. Turn control knob to highlight **ROUTE ON** or **ROUTE OFF**, then push to enter.

Strike or Cell Mode

1. Press the **MENU** button.
2. Select the **FORMAT . .** menu.
3. Turn control knob to highlight **STRK MODE** or **CELL MODE**, then push to enter.

See the WX-500 documentation for more information.

Clear Strikes

To clear residual strike symbols from the display:

1. Press the **MENU** button.

2. Select the **CLR STRKS . .** menu. Strikes will be cleared from screen.

See the WX-500 documentation for more information.

Strike Test

To perform a pilot-initiated test of the WX-500 system:

1. Press the **MENU** button.
2. Select the **FORMAT . .** menu.
3. Turn control knob to highlight **STRK TEST**, then push to enter.

See the WX-500 documentation for more information.

Controlling the Traffic Display

These procedures refer only to the dedicated Ryan International TCAD display function and are available only when a Ryan 9900B or 9900BX TCAD or an L-3 Skywatch is connected to the system. The traffic display can only be shown in “centered” mode.

Route On or Route Off

To show or hide the active route while in the dedicated traffic display function:

1. Press the **MENU** button.
2. Select the **FORMAT . .** menu.
3. Turn control knob to highlight **ROUTE ON** or **ROUTE OFF**, then push to enter.

Traffic Test

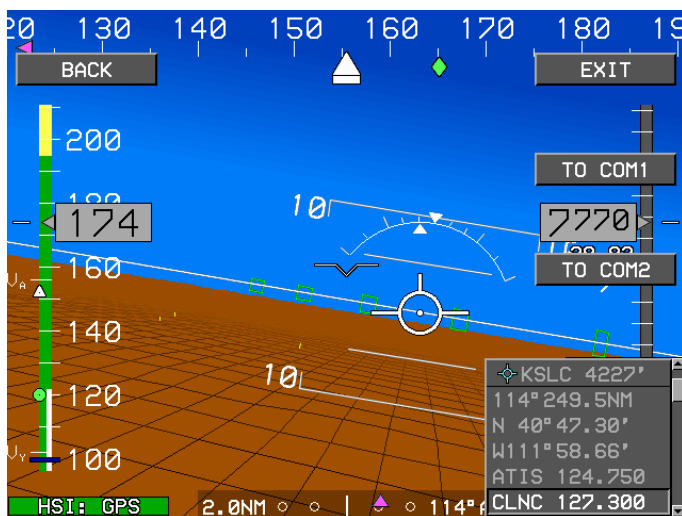
To perform a pilot-initiated test of the TCAD system:

1. Press the **MENU** button.
2. Select the **FORMAT . .** menu.
3. Turn control knob to highlight **TEST**, then push to enter.

See the Ryan International TCAD or L-3 Skywatch documentation for more information.

Tuning Radios using the EFIS

When the FlightLogic EFIS is connected to a Bendix/King KX-155A or KX-165A or a UPS/GarminAT SL-30 nav/com, frequencies may be sent to the standby position on the radio directly from the EFIS.



1. Display the information for the facility (see **Waypoint Information (NavData)**, page 5-38).
2. Turn the control knob to highlight the desired frequency. Menu functions will appear as appropriate to send the frequency to the com or nav radios.
3. Press **TO COM1** or **TO COM2** (or **TO NAV1** or **TO NAV2**) to send the frequency to the standby position of the com (or nav) radio.

Press **BACK** or **EXIT** when finished.

Analog Autopilot Interface

Most autopilots are analog and interface with the EFIS using the optional AIU. See **Analog Interface Unit (AIU)**, page 2-30. Operation of your analog autopilot when interfaced with the FlightLogic EFIS becomes extremely simple.

Departure, Enroute, and Arrival Procedures

1. Put your autopilot in **HEADING** mode.
2. Activate a waypoint, flight plan, DP, STAR, heading bug, or manual GPS OBS.

The autopilot will fly through the skyway and trace the courseline on the moving map using analog roll steering.

When your autopilot is in **HEADING** mode, setting a heading bug or manual GPS OBS overrides the course shown on the EFIS. When the heading bug is turned off and the GPS OBS set to **AUTO**, the autopilot will automatically reintercept the course. If no course or heading bug exists, the autopilot will function as a wing leveler.

Non-precision approaches

1. Put your autopilot in **HEADING** mode.
2. Activate an approach or missed approach procedure.

The autopilot will fly through the skyway and trace the courseline on the moving map using analog roll steering.

Vertical navigation cues will be provided by the EFIS (the skyway will indicate a descent) but the pilot must manipulate the throttles and altitude function of the autopilot to control the descent.

Precision approaches

Follow steps 1 and 2 above, then:

3. At the initial approach fix, set the HSI Source to the nav receiver that is tuned to the localizer frequency (press **OBS**, then **HSI: NAV 1** or **HSI: NAV 2** as appropriate) and, using the control knob, set the OBS to the final approach course (use **OBS** button or **NRST, ILS, SYNC**). Push the control knob to enter.
4. On the inbound course, prior to the final approach fix, put the autopilot in **APPR** mode (or **NAV** mode if you do not have an **APPR** mode). The autopilot will then use the analog ILS signals to fly the coupled approach.

NOTE:

*Some autopilots must be in **ALTITUDE HOLD** or **GLIDESLOPE** mode to enable glideslope capture. See your autopilot flight manual supplement for more information.*

Vectors to final

Follow the steps above but use the heading bug on the EFIS to follow the controller's instructions to intercept the final approach course. Just prior to the final approach fix, put the autopilot in **APPR** (or **NAV**) mode and turn the EFIS heading bug **OFF**.

Missed approaches

1. Ensure the EFIS heading bug is **OFF** and press the **MISSED** menu button on the EFIS after you pass the final approach fix.
2. Put the autopilot back in **HDG** mode at the missed approach point and execute a climb.

Example of a typical approach sequence:



Autopilot is already in **HDG** mode (analog roll steering) from enroute legs.

- 1 20-30 miles out, get ATIS, set altimeter, enter approach, and set minimum altitude bug.
- 2 Tune localizer frequency on your nav receiver, set the HSI source on the EFIS to that receiver, and set the OBS course (use **NEAREST - ILS** then **SYNC** for instant OBS setting).
- 3 Press the **APPR** (or **NAV**) button on the autopilot.
- 4 Press the **HDG** button on the autopilot and initiate a climb to fly the missed.

***“Which mode when?”***

*When your autopilot is in **HEADING** mode, it will follow the **heading bug** or **skyway** displayed on the EFIS. Following the skyway, it will fly DPs, STARS, approaches with procedure turns or holding pattern course reversals or DME arcs, and even complete missed approach procedures including the holding pattern and the correct entry completely hands off. Unlike a conventional autopilot flight director, the skyway will provide you with turn anticipation so you will know what your autopilot is **going** to do, long before it actually makes a turn. You will, however, have to control the vertical navigation manually as you have always done.*

*When your autopilot is in **NAV** or **APPR** mode, it will follow the **navigation signal** from whichever nav source is displayed in the green advisory flag in the lower left corner of the EFIS. When flying a precision approach, use the **APPR** mode if you have one and **NAV** mode if you don't.*

Digital Autopilot Interface

Some autopilots have a digital roll steering interface. The EFIS will send digital roll steering (lateral navigation) commands directly to the autopilot which will enable the autopilot to fly the depicted courseline when it is in roll steering mode. Refer to your autopilot flight manual supplement for appropriate procedures.

NOTE:

*Digital roll steering (ARINC429 Label 121) is **ONLY** sent when HSI Source is set to **GPS**.*

Section 6

Quick Start Tutorial



1. Begin by reading the Chelton EFIS Supplement in your aircraft's Flight Manual. Pay special attention to the Emergency, Abnormal, and Normal Procedures sections (which are included in the Appendix of this guide for reference).



2. Power up the EFIS. The system will perform a built-in test routine. If all tests are passed, the system will display a screen identifying the database coverage. Press any button to acknowledge and the system will begin a two-minute countdown while awaiting sensor initialization (for the purposes of flight planning, etc., this countdown can be overridden by pressing any button).

NOTE:

Allow the system to initialize for 90 seconds before taxiing to ensure proper initialization of the AHRS.



RIGHT

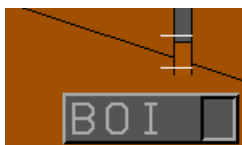
3. Note that the altimeter is adjusted automatically on startup based on the touchdown zone elevation of the nearest runway. If necessary, adjust the setting by turning the right-hand control knob on the display. The altimeter setting will be displayed immediately below the altitude readout on the PFD. Push the knob to enter the setting.



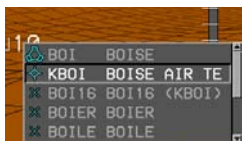
4. Press the **Direct-To** button to enter a destination.



5. Use the control knob (turn to select, push to enter), to enter the desired waypoint.



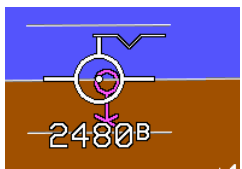
For example: To enter the Boise airport, turn to select “**B**” then push to enter; turn to select “**O**” then enter; turn to select “**I**” then enter. **Push two more times to step through the last two character spaces** (the leading “**K**” identifier may be entered but is not required). An exact match will be accepted and entered automatically.



If there is no exact match, a list of potential matches will be displayed.



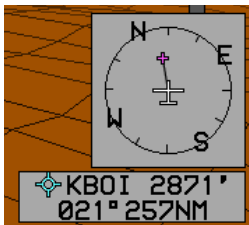
6. Turn control knob to select the desired waypoint, then push to enter.



7. A route to the selected waypoint will be activated. The active waypoint will be shown as a tethered balloon on the PFD screen.



A magenta bearing to waypoint symbol will be displayed on the desired track on the directional scale. If the bearing to the waypoint is beyond the limits of the directional scale, a magenta arrow on the scale will indicate the closest direction to turn.



The waypoint information, indicating waypoint type and identifier, elevation or crossing altitude, and bearing and distance, will be displayed immediately below the MiniMap.

The waypoint information, indicating waypoint type and identifier, elevation or crossing altitude, and bearing and distance, will be displayed immediately below the MiniMap.



Airspeed is on the left, altitude is on the right, heading is across the top, and a GPS/WAAS CDI is at the bottom. VSI is to the right of the altitude tape.



PUSH

8. Push the control knob to step through the screens on the MFD as follows:

ND → reversionary PFD → engine display (if available) → ND

(Note: the PFD cannot be changed)



TURN

9. When on the moving map page, turn the control knob clockwise to increase scale and counter-clockwise to decrease scale (range is from 1 to 400 miles).

Now you should be familiar enough with the basic operation of your Chelton Flight Systems EFIS to navigate from point to point in VFR conditions and change from one display page to another. Please read this entire manual and fly with a Chelton Authorized Instructor to gain a detailed understanding of all system features.

SECTION 7

IFR Procedures

Overview of Approaches

Your Chelton EFIS provides three-dimensional GPS non-precision instrument approach guidance using an integral GPS receiver. The Chelton GPS complies with TSO-C145a/146a and may be used for stand-alone, sole-source enroute navigation and GPS/RNAV and “GPS overlay” approaches. Approaches designed specifically for GPS are often very simple and don’t require overflying a VOR or NDB. Currently, many non-precision approaches have GPS overlays to let you fly an existing procedure (VOR, VOR/DME, NDB, etc.) more accurately using GPS, although many of these approaches are complex (compared with GPS-only approaches). Using the skyway guidance offered by the Chelton EFIS, however, makes all approaches equally simple.

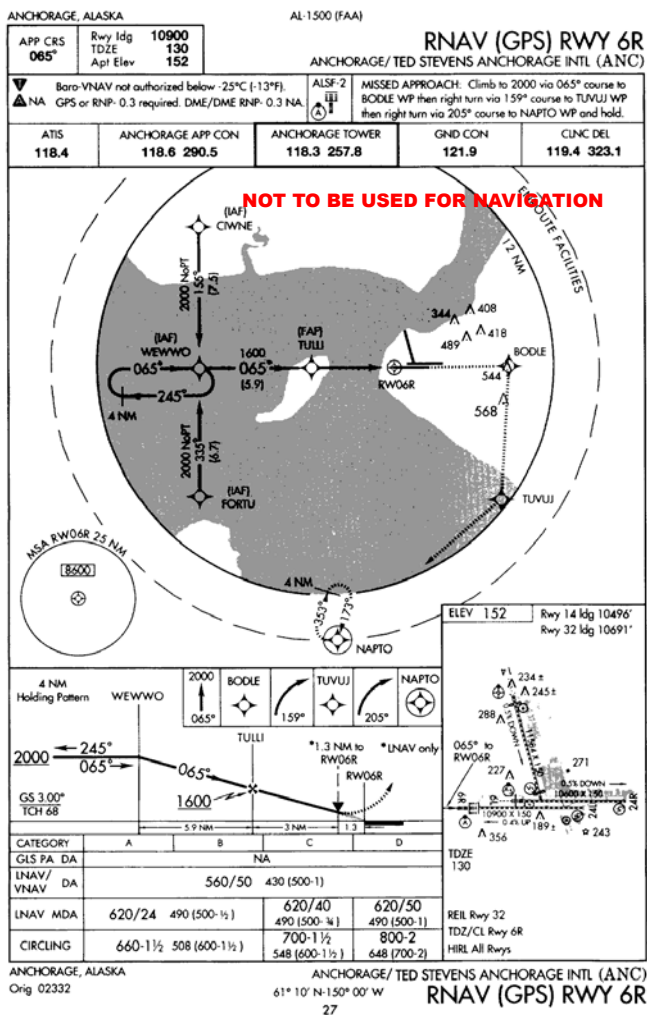
NOTE:

WAAS or Fault Detection and Exclusion (FDE) must be available at the Final Approach Fix to continue an approach.

The Chelton EFIS PFD and moving map guide you through every step of the approach using extremely precise 3-D skyway symbology. The system automatically sequences through each leg, up to the missed approach point (MAP), and through the complete missed approach procedure including holds. Approaches may be flown “as published” with the full transition, using any published route or initial approach fix (IAF), or with a vectors-to-final (VTF) transition.

When coupled to your autopilot, the EFIS will fly complete procedures with little or no pilot interaction.

Basic Instrument Approach Operation

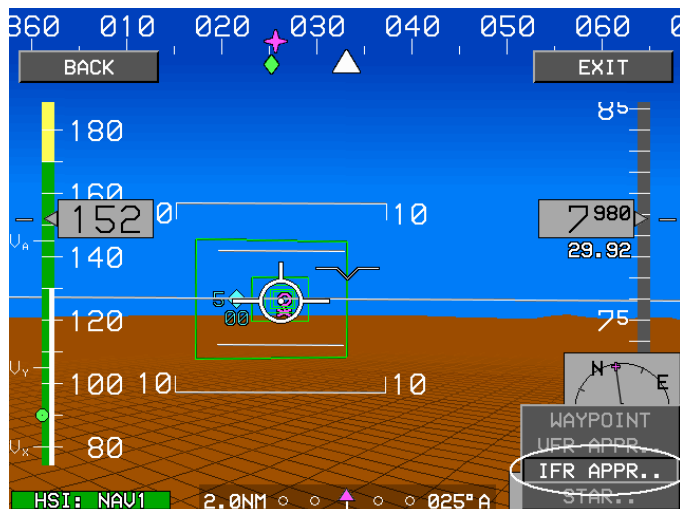


All approach operations will typically begin with the same basic steps (This example selects the GPS approach to runway 6R at Anchorage):

1. You must have the intended landing airport as the active waypoint (either selected from an active flight plan using **ACTV** or entered using **Direct-To** or **NRST**).
2. Press the **ACTV** button.
3. Turn the control knob to select the desired airport and press to enter.



4. Choose **IFR APPR...**



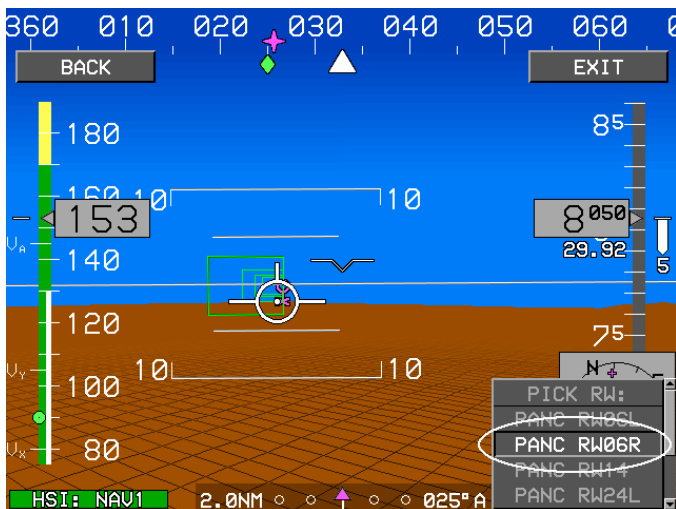
5. Choose the desired **approach (APPR)**.

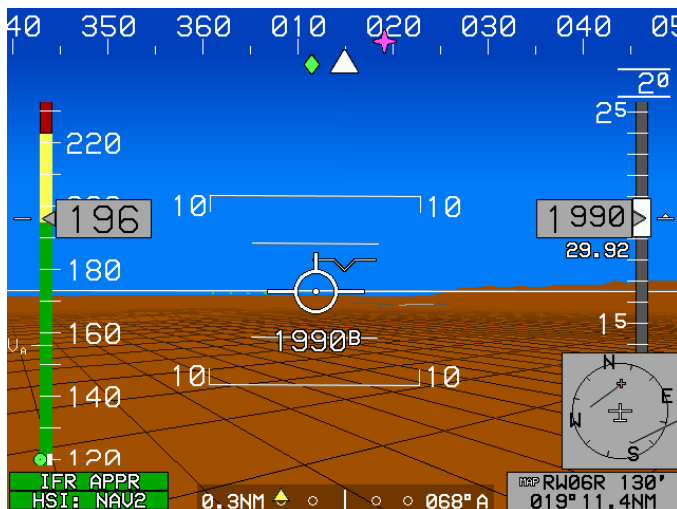


6. Choose the desired **transition (TRANS)** or vectors to final (- VTF -).



7. Choose the desired **runway (RW)**.





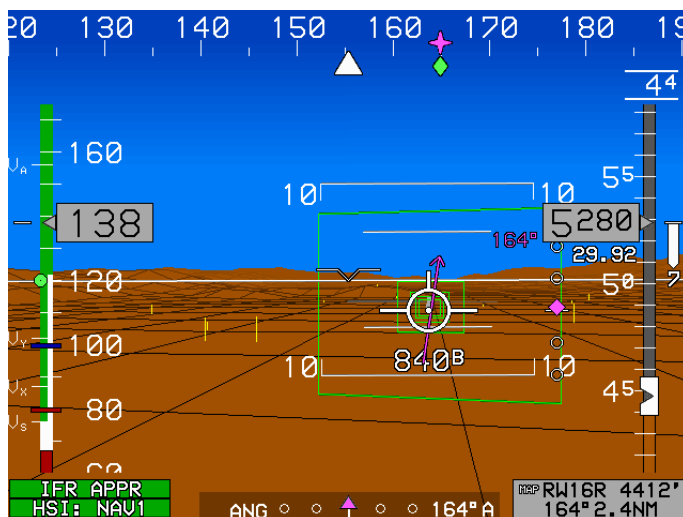
“Where’d the boxes go?”

In this example, we chose vectors-to-final so the skyway boxes are no longer drawn from the last waypoint to the destination; they are drawn along the final approach course to the runway. They are visible just below the artificial horizon and to the left of the flight path marker. Notice the MiniMap shows a small line extending down to the 8 o’clock position from the waypoint; that is the final approach course and the boxes are lined up along it. The runway is visible to the right of the flight path marker, just below the horizon.”

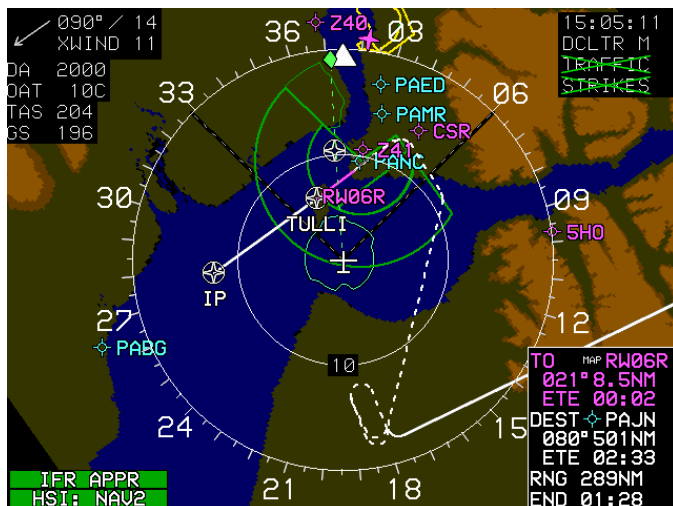
Within 30NM of the destination airport, a “TERMINAL” flag appears to annunciate that the EFIS is in terminal mode and automatic CDI scaling gradually transitions from 2.0NM (enroute) to 1.0NM (terminal). On the final approach segment, the flag will read IFR APPR and CDI scaling will transition from 1.0 NM to 0.3 NM. Inside the final approach fix the CDI scaling becomes angular like a localizer.

The first waypoint will be displayed conformally on the PFD and the crossing altitude will be automatically entered as the target altitude. The fix, distance, bearing, and crossing altitude will be displayed in the waypoint information box in the lower-right corner of the PFD.

Regardless of the type of approach, a stabilized descent is good practice. In the past, it was common to “dive and drive” on step down approaches to allow for more time at the minimum descent altitude to find the runway. With skyway guidance and a conformal runway depiction, that is no longer necessary. Likewise, needle chasing on the ILS is common, especially for pilots who don’t fly them regularly. Once established on the ILS, use the skyway, runway, and flightpath marker to stabilize your approach. The result will be fewer control movements, superior speed control, and extremely precise ILS tracking. If you keep the flight path marker in the smallest green box or on the runway as shown on an ILS below, the needles will hardly move.



The EFIS will automatically sequence through approach waypoints as the approach is flown. The approach procedure will appear on the moving map as solid white lines, except for the active leg, which is displayed in magenta. The missed approach procedure will appear on the navigation display as dashed lines. The navigation display will also show procedure turns, arcs and holding patterns as appropriate.



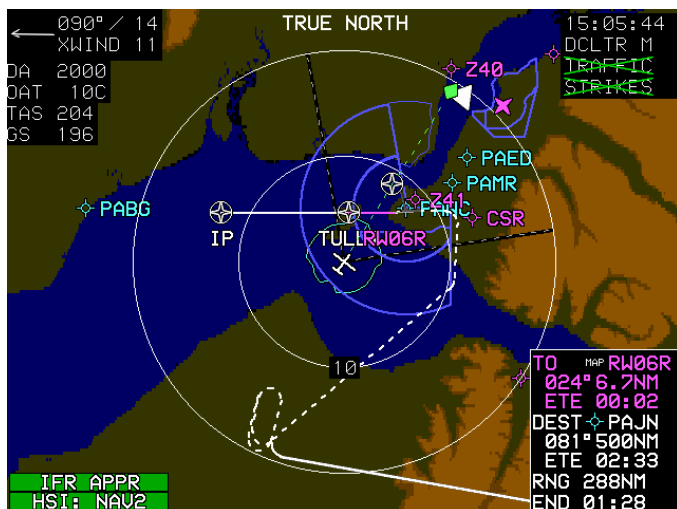
“Just follow the magenta line:

*Here, we are inbound toward the final approach course. Remember, the skyway boxes will always be positioned along the magenta line so if you lose them on the PFD, just look for the magenta line on the moving map (remember, they could be above you or below you based on the target altitude, or you could have a discontinuity, see **Discontinuity**, page 3-122). Also, remember that all turns in a procedure are actual size based on a 15° bank (zero wind) at the preprogrammed V_{PROC} , or procedure speed for your aircraft. If you are going faster or slower, you will need more or less bank angle, respectively, to stay in the boxes.”*

NOTE:

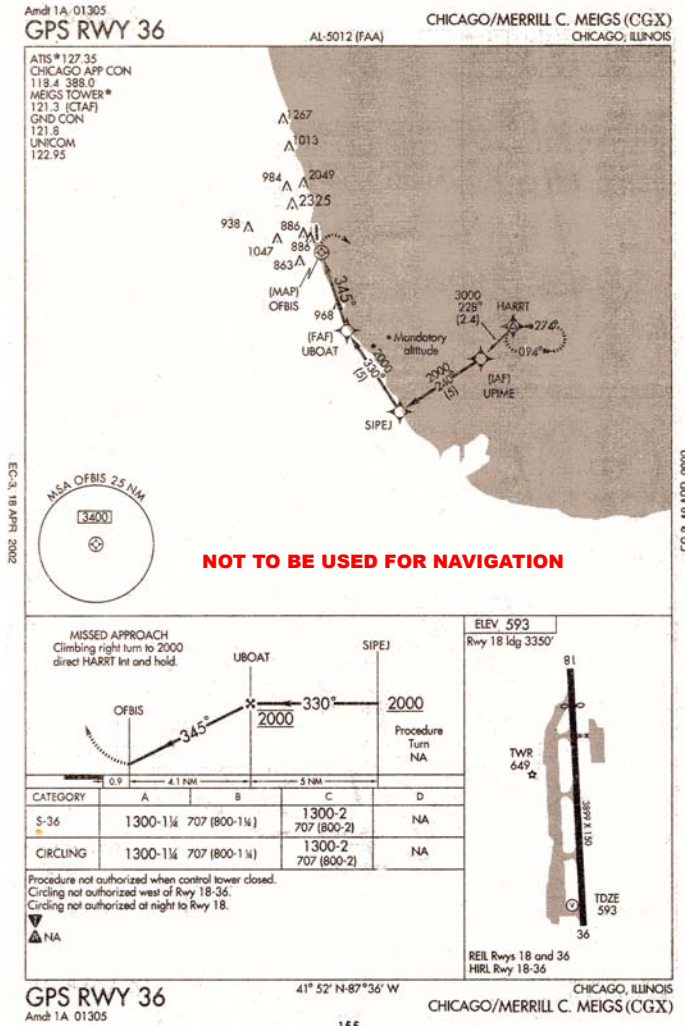
During a Non-Precision Approach, the primary instruments are the Course Deviation Indicator (CDI) and the Altimeter. The Skyway provides reference to the approach path and a stabilized approach path from the Final Approach Fix (FAF) altitude to the Missed Approach Point (MAP) reference altitude. The Skyway may descend below the Minimum Descent Altitude. The Altimeter must be used to maintain the appropriate altitudes during the approach procedure.

Changing the format of the navigation display to North-Up (by using the **FORMAT** menu) will make the display match an approach chart. Use the navigation display approach procedure depiction and the primary flight display CDI and Skyway for course guidance and turn anticipation.



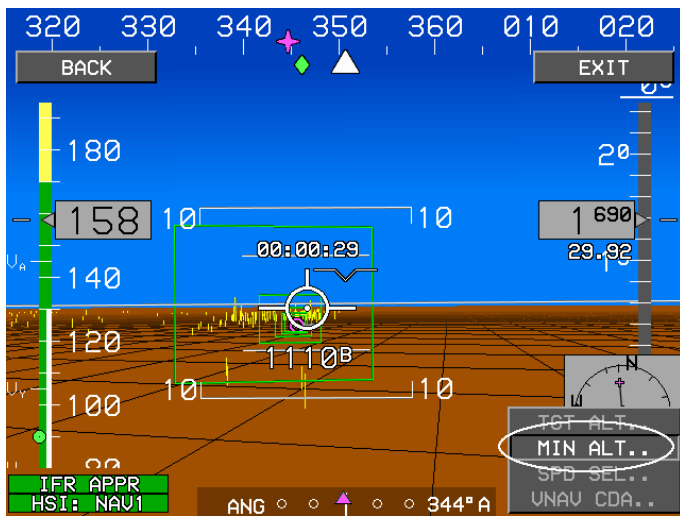
You may review the bearing, distance, procedure type, and crossing altitude for each waypoint in the approach by scrolling to each waypoint in the **ACTV** menu and pressing **INFO**. Once you have verified the waypoints and crossing altitudes and entered a minimum altitude bug, you can set the approach plate aside and concentrate on flying the airplane.

You will notice differences from time to time between the Jeppesen NavData on the EFIS and the published paper charts. Due to the complexities of converting paper charts to a navigation database, errors and omissions occasionally occur. These differences are usually limited to minor inconsistencies among crossing altitudes and waypoint locations and do not impose a threat to flight safety. However, always verify the legs of an approach using a paper chart before performing the approach. The paper chart is the legal and approved data so it takes precedence over the Jeppesen NavData stored in the system.



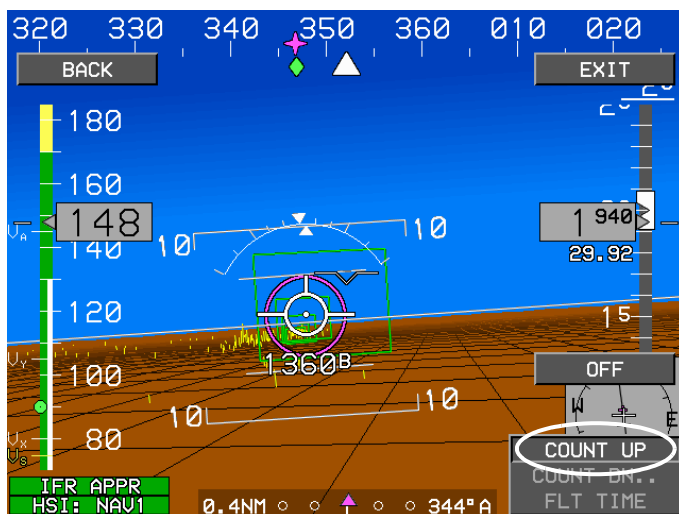
This example uses the GPS approach to 36 at Chicago's Meigs Field. As the approach is flown, target altitudes will be automatically updated. However, the minimum altitude bug

must be set manually according to the MDA or DH as specified on the published instrument approach plate.



Within 2.0NM of the Final Approach Fix (FAF), automatic CDI scaling gradually transitions from 1.0NM (terminal) to 2° angular (approach) like a localizer.

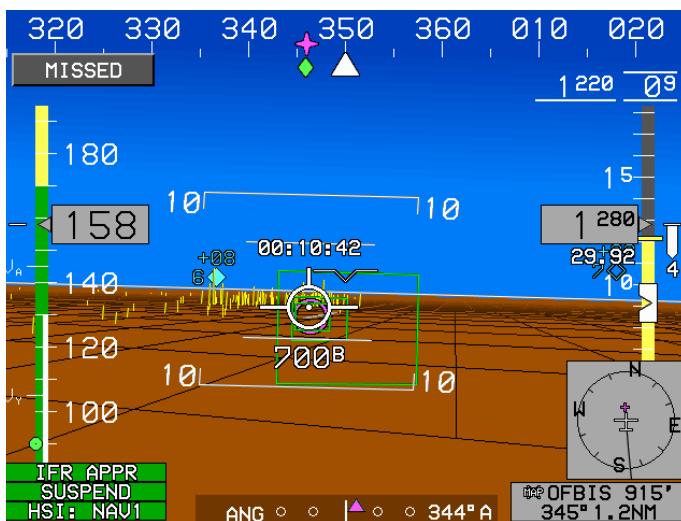
Use the **TIMER . .** function (count up or count down) for approaches that require timing from the Final Approach Fix to the Missed Approach Point.



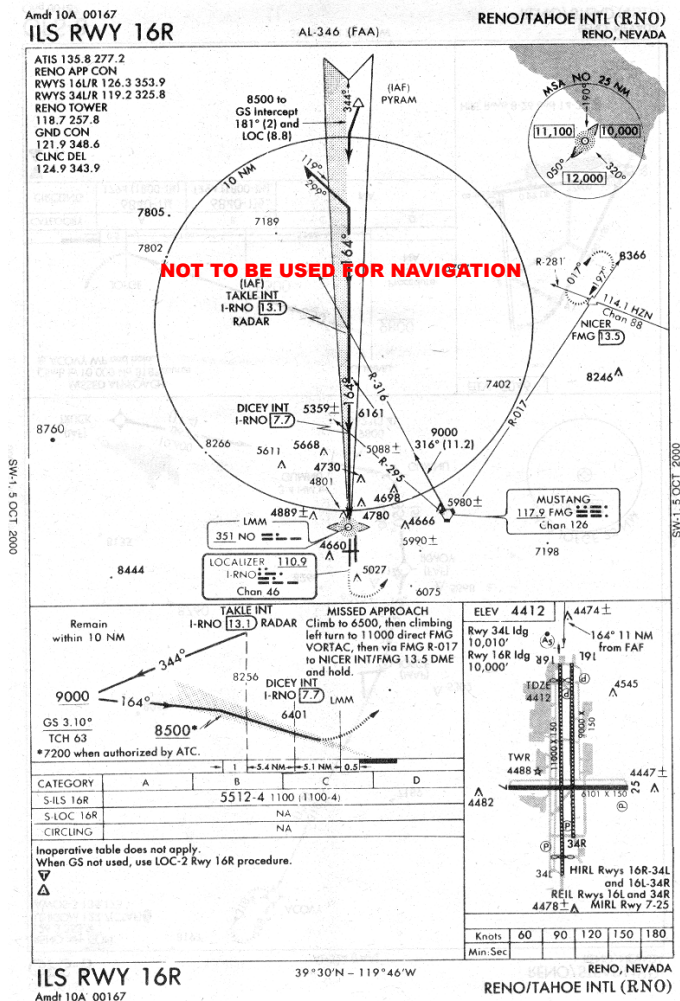
Once past the FAF, waypoint sequencing automatically suspends so as to provide CDI guidance along the extended final approach course past the MAP. “SUSPEND” is annunciated with a green advisory flag and the **MISSED** menu appears in the upper left corner. Press **MISSED** to arm the missed approach procedure (the SUSPEND flag will disappear); the missed approach procedure will be automatically activated upon passing the missed approach point. For more information on the SUSPEND mode, see **Waypoint Sequencing, page 3-10**.

The runway depiction, with associated skyway, aids in visualizing the runway environment, especially in situations where the final approach course and the runway are not aligned.

Neither the MAP waypoint symbol (magenta tethered balloon) nor an associated target altitude are shown so that the depicted runway can be seen more clearly. Refer to the minimum altitude bar for MDA and DH guidance.



Approaches with Course Reversals



An approach may contain a course reversal, commonly in the form of a procedure turn and less commonly in the form of a holding pattern or teardrop.

- The procedure turn portion of an approach is stored as one of the legs of the approach. For this reason, there are no special operations required of the pilot, other than flying the procedure turn itself when appropriate.
- The holding pattern is composed of two legs, the entry and the hold itself. When the active leg automatically sequences from the entry to the holding pattern, the entry leg will be removed from the moving map, the **CONTINUE** menu will be displayed, and automatic waypoint sequencing will be suspended (annunciated by a “SUSPEND” flag). To continue the approach beyond the hold, the pilot need only press the **CONTINUE** button.

Approaches with Procedure Turns:

This example of a procedure turn uses the ILS Runway 16 approach for Reno (Nevada) Regional Airport, KRNO. The steps required to set up and fly the approach are detailed below:

1. You must have the airport entered as a waypoint (using **NRST**, **Direct-To**, or as part of an active flight plan).
2. While enroute to KRNO, approximately 40NM away, select the proper frequency to obtain airport conditions and runway usage. Frequency information is available for the destination airport by selecting the **INFO . .** menu, see **Waypoint Information (NavData)**, page 5-38. From ATIS or ATC, you learn that runway 16R is in use and plan your approach accordingly.
3. Press the **ACTV** button, and select **IFR APPR . .** then the airport (**KRNO**) then **ILS16R** then the desired transition **FMG** (Mustang VOR) and finally the desired runway (**RW16R**). The approach will now be entered and displayed as a white courseline on the moving map, except the active leg, which will be magenta.

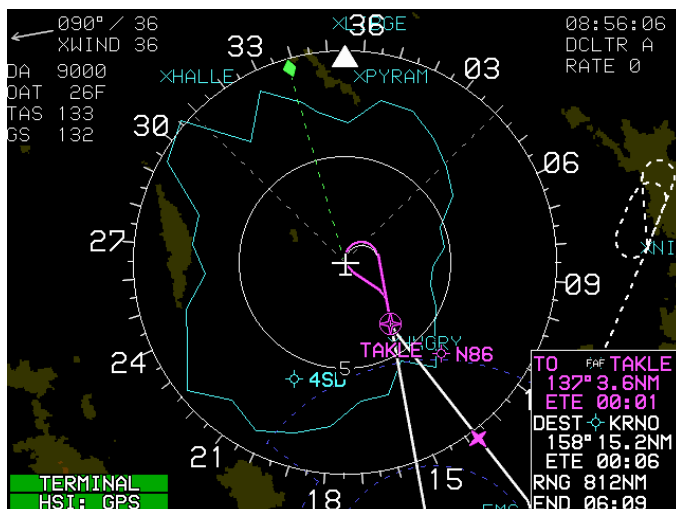
Within 30 nautical miles of the destination airport, the system will transition from “enroute” mode to “terminal” mode. The

change to terminal mode is accompanied by a gradual CDI scale transition from 2.0 to 1.0NM.

You may review the approach sequence at any time by pressing the **ACTV** button. Turn the control knob to review each segment of the approach. Bearing and distance information will be displayed for each waypoint. Press **INFO** to review crossing altitudes. When finished, press **EXIT** to remove menus from the screen.

As you approach the IAF (FMG), the active waypoint will be displayed as a “tethered balloon” shown on the PFD. The active leg will be displayed on the moving map. Distance, bearing and ETE will appear in the bottom right corner of the moving map. Waypoints will sequence automatically as the flight progresses. Skyway boxes will connect the waypoints to guide you through the entire procedure. No further pilot action is required.

As you pass over the procedure turn waypoint, the procedure turn segment becomes active and is displayed in magenta on the moving map. Skyway boxes continue to guide you through the turn back to the final approach fix.



Within 2.0NM of the final approach fix, the display will switch from “terminal” mode to “approach mode.” The switch to terminal mode is accompanied by a gradual CDI scale transition from 1.0 to 0.3NM. Skyway boxes display appropriate descent points and altitudes for the approach.

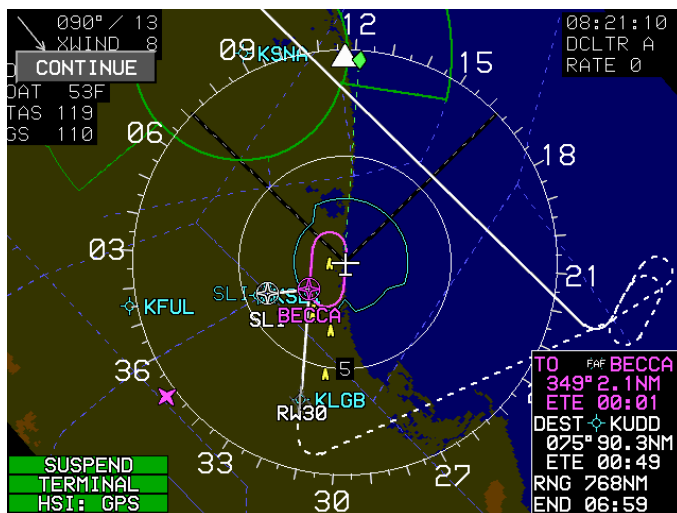
As you cross the FAF, the destination sequences to the MAP (RW16R in this example) and the CDI scale becomes angular like a localizer. Continue flying through the skyway toward the MAP. The **MISSED** menu button will be shown in the upper left corner of the screens and automatic waypoint sequencing will be suspended upon crossing the FAF. Pressing the **MISSED** menu button at this point arms the missed approach procedure and re-enables automatic waypoint sequencing. Even though **waypoint crossing altitudes are automatically entered** from the Jeppesen database, decision height or minimum descent altitude are **NOT** in the Jeppesen NavData and **MUST** be determined using the published instrument approach charts. These may be entered as a minimum altitude bug.

If the **MISSED** was armed, the first waypoint of the missed approach procedure becomes active upon passing the MAP. If not, guidance continues straight ahead along the extended runway centerline.

Approaches with Holding Patterns:

Select the approach in the same manner as described above.

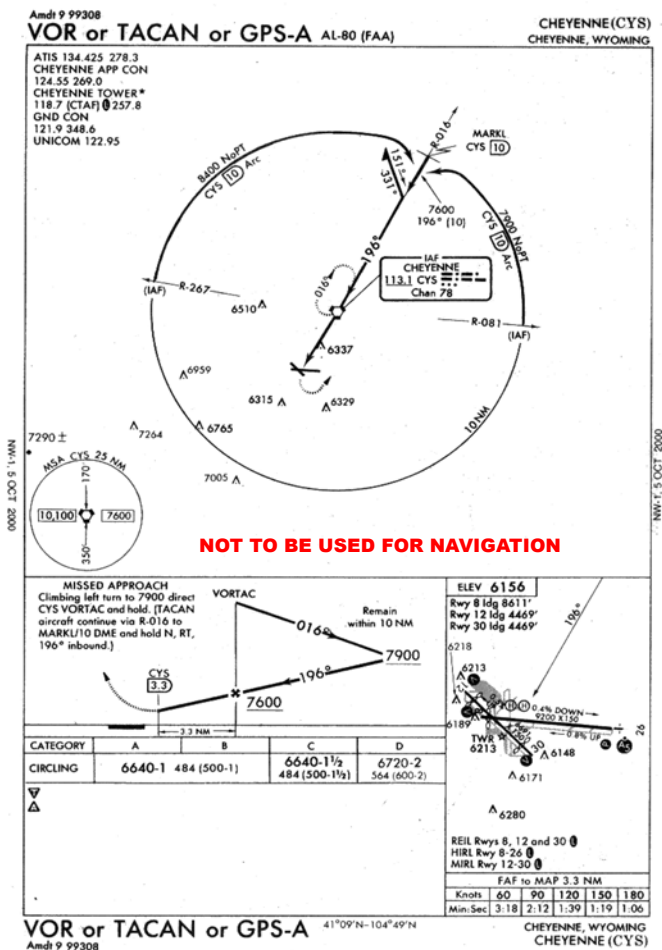
The courseline on the moving map and the skyway on the PFD will provide guidance and turn anticipation throughout the procedure, including the entry to the hold (parallel, teardrop, or direct, which will be automatically calculated).



Automatic waypoint sequencing will be suspended once you are established in the holding pattern and the entry leg will be removed (as shown in the example above).

To continue the approach from the holding pattern and re-enable automatic waypoint sequencing, just press **CONTINUE**. In this example, the MAP (runway 30) will then become the active waypoint upon passing BECCA.

Approaches with DME Arcs



The GPS overlay for a DME arc approach uses additional Jeppesen waypoints to define the arc. These waypoints are indicated by “D” as the first letter in the waypoint name. This is followed by three numbers which indicate the radial the waypoint lies on. The last letter indicates the radius of the arc.

For example:

“D258G” indicates a DME waypoint (D) on the 258 degree radial on a 7 DME arc (G being the seventh letter of the alphabet.)

NOTE:

*For additional information on waypoint names, see **Navdata Name Conventions: Waypoint Identifiers**, page 8-44.*

When you are cleared for the approach, you may do either of the following to establish yourself on the approach:

- Use the IAF waypoint, defined by a specific radial along the arc.
 - Follow ATC vectors which allow you to intercept the arc at any point along the arc.
1. You must have the airport entered as a waypoint (using **NRST**, **Direct-To**, or as part of an active flight plan).
 2. While enroute to KCYS, approximately 40 nautical miles away, select the ATIS frequency to monitor airport conditions and runway usage. Frequency information is available for the destination airport by selecting the **INFO . .** menu, see **Waypoint Information (NavData)**, page 5-38. From ATIS or ATC, you learn that runway 8 is in use and plan your approach accordingly.
 3. Press the **ACTV** button, and select **IFR APPR . .** then the airport (**KCYS**) then **VOR A** then the desired transition **D267J** (10-mile DME arc at the 267° radial) and finally the desired runway (**RW08**). The approach will now be entered and displayed as a white courseline on the moving map, except the active leg, which will be magenta.

Within 30 nautical miles of the destination airport, the system will transition from “enroute” mode to “terminal” mode. The change to terminal mode is accompanied by a gradual CDI scale transition from 2.0 to 1.0NM.

You may review the approach sequence at any time by pressing the **ACTV** button. Turn the control knob to review each segment of the approach. Bearing and distance information will be displayed for each waypoint. Press **INFO** to review crossing altitudes. When finished, press **EXIT** to remove menus from the screen.

As you approach the IAF (D267J), the active waypoint will be displayed as a “tethered balloon” shown on the PFD. The active leg will be displayed on the moving map. Distance, bearing and ETE will appear in the bottom right corner of the ND. Waypoints will sequence automatically as the flight progresses. Skyway boxes will connect the waypoints to guide you through the entire procedure. No further pilot action is required.



The skyway and CDI will provide you with continuous guidance throughout the arc, including the inbound turn from the arc to the final approach course, along with turn

anticipation. Simply steer the flight path marker through the boxes and you will make a smooth transition from the arc to the final approach course.

Within 2.0NM of the final approach fix, the display will switch from “terminal” mode to “approach mode.” The switch to terminal mode is accompanied by a gradual CDI scale transition from 1.0 to 0.3NM. Skyway boxes display appropriate descent points and altitudes for the approach.

As you cross the FAF, the destination sequences to the MAP (CYS 3.3 DME in this example) and the CDI scale becomes angular like a localizer. Continue flying through the skyway toward the MAP. The **MISSED** menu button will be shown in the upper left corner of the screens and automatic waypoint sequencing will be suspended upon crossing the FAF. Pressing the **MISSED** menu button at this point arms the missed approach procedure and re-enables automatic waypoint sequencing. Even though **waypoint crossing altitudes are automatically entered** from the Jeppesen database, decision height or minimum descent altitude are **NOT** in the Jeppesen NavData and **MUST** be determined using the published instrument approach charts. These may be entered as a minimum altitude bug.

If the **MISSED** was armed, the first waypoint of the missed approach procedure becomes active upon passing the MAP. If not, course guidance is provided straight ahead along the extended runway centerline.

NOTE:

To fly a DME arc without the skyway, use the RMI on the moving map or HSI; keeping it perpendicular to the longitudinal axis of the aircraft symbol will greatly simplify the arc procedure.

Vectors to Final (VTF)

When a VTF IFR approach is selected, the system will create an “IP” (Initial Point) waypoint on the extended final approach course. This is designed to allow intercept anywhere along the final approach course. **Use the heading bug to follow ATC vectors to join the final approach course.**

The IP will be designated a fly-over waypoint, and the leg prior to the IP be a discontinuity, see **Discontinuity, page 3-122** (if you do not use the heading bug, the EFIS will set up an intercept to fly over the IP on the inbound course.)

Until the FAF has been passed, the system will display an advisory flag indicating that a VTF IFR approach has been selected. This is to advise the pilot that guidance is not relative to a published approach path and that **procedure clearances are not assured**.



1. You must have the airport entered as a waypoint (using **NRST**, **Direct-To**, or as part of an active flight plan).
2. While enroute to KAAT (in the example above), approximately 40 nautical miles away, select the appropriate frequency to determine airport conditions and runway usage.

Frequency information is available for the destination airport by selecting the **INFO . .** menu, see **Waypoint Information (NavData)**, page 5-38. From ATIS or ATC, you learn that runway 31 is in use and plan your approach accordingly.

3. Press the **ACTV** button, and select **IFR APPR . .** then the airport (**KAAT**) then ***GPS31** (the asterisk indicates the approach is approved for GPS), then the vectors-to-final transition - **VTF -**, and finally the desired runway (**RW31**). The approach will be shown as a solid magenta line beginning at the IP and terminating at the MAP.

Within 30 nautical miles of the destination airport, the system will transition from “enroute” mode to “terminal” mode. The change to terminal mode is accompanied by a gradual CDI scale transition from 2.0 to 1.0NM.

Using the headin bug, follow ATC vectors to join the final approach course.

Within 2.0NM of the final approach fix, the display will switch from “terminal” mode to “approach mode.” The switch to terminal mode is accompanied by a gradual CDI scale transition from 1.0 to 0.3NM. Skyway boxes display appropriate descent points and altitudes for the approach.

As you cross the FAF (TEFAN in this example), the destination sequences to the MAP (runway 31) and the CDI scale becomes angular like a localizer. Continue flying down the skyway toward the MAP. The **MISSED** menu button will be shown in the upper left corner of the screens and automatic waypoint sequencing will be suspended upon crossing the FAF. Pressing the **MISSED** menu button at this point arms the missed approach procedure and re-enables automatic waypoint sequencing. Even though **waypoint crossing altitudes are automatically entered** from the Jeppesen database, decision height or minimum descent altitude are **NOT** in the Jeppesen NavData and **MUST** be determined using the published instrument approach charts. These may be entered as a minimum altitude bug.

If the **MISSED** was armed, the first waypoint of the missed approach procedure becomes active upon passing the MAP. If not, continued guidance is provided straight ahead along the extended runway centerline.

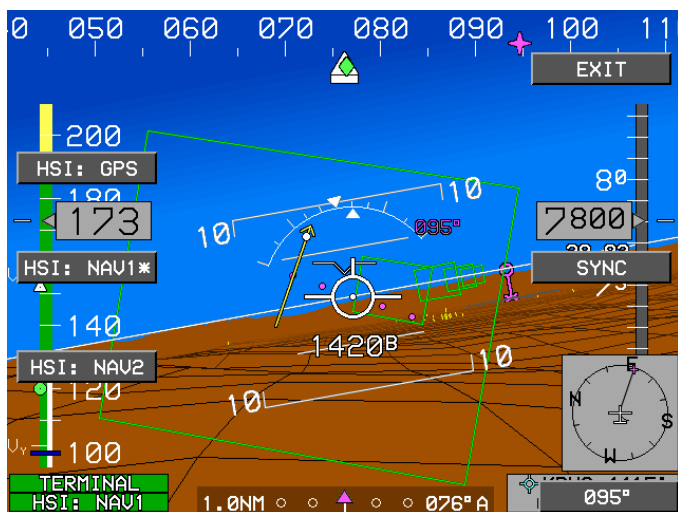
ILS Approaches

ILS approaches are set up and flow in the same manner as all other approaches except they rely on the ground-based localizer and glideslope transmitters for lateral and vertical navigation.

The skyway will continue to provide both lateral and vertical guidance for the entire approach. However, unlike non-precision approaches, **the raw data from the localizer and glideslope must be used as the primary reference during the approach.**

The following steps should be added to the previously described approach procedures when flying an ILS:

1. Autopilot should be in **HEADING** mode and following the skyway or EFIS heading bug.
2. Press the **OBS** button and set the HSI source to the appropriate nav source (**HSI: NAV1** or **HSI: NAV2**).



The HSI will not be displayed until a valid nav signal is received. The asterisk and an advisory flag indicate the selected source.

- Press **NRST**, and use the control knob to choose ILS, then scroll to the appropriate ILS transmitter and press **CRS SYNC**.



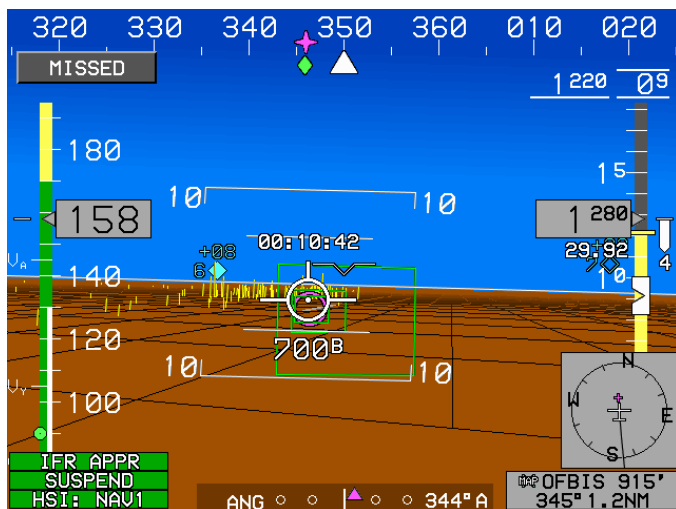
The HSI needle will be automatically set to the final approach course.

- If properly equipped, press **TO NAV1** or **TO NAV2** to send the ILS frequency to the standby position of the nav receiver you specified in **Step 2** as the HSI source. Switch the frequency into the active position on you nav receiver and verify the signal.
- On the inbound course, prior to intercepting the glideslope, place the autopilot in APPROACH mode.

During the approach, the raw localizer and glideslope data serve as your primary cues and drive the autopilot, however, you should use the flight path marker and skyway to stabilize and improve the precision of your approach.

Missed Approaches

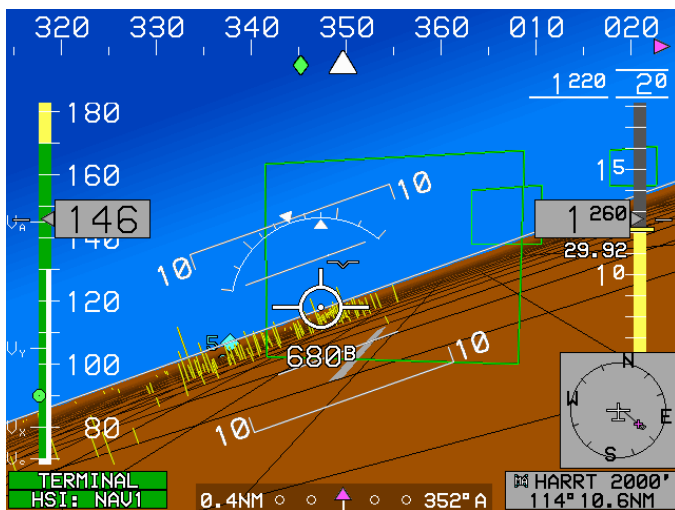
Upon passing the FAF, **MISSED** appears in the upper left hand corner and automatic waypoint sequencing is suspended (see **Waypoint Sequencing**, page 3-10 for more information).



Pressing the **MISSED** menu arms the missed approach and re-enables automatic waypoint sequencing. Navigation continues until passage of the Missed Approach Point (MAP). Upon passing the MAP navigation sequences to the first waypoint of the missed approach procedure and the system returns to “terminal” mode.

If the missed approach is not armed, CDI guidance continues along the extended final approach course. **MISSED** may be pressed at any time.

Most missed approaches end with a holding pattern, in which case automatic waypoint sequencing is suspended and must be re-enabled by manually by pressing **CONTINUE** (if there is a subsequent waypoint in the active flight plan) or activating another waypoint using the **ACTV** menu.



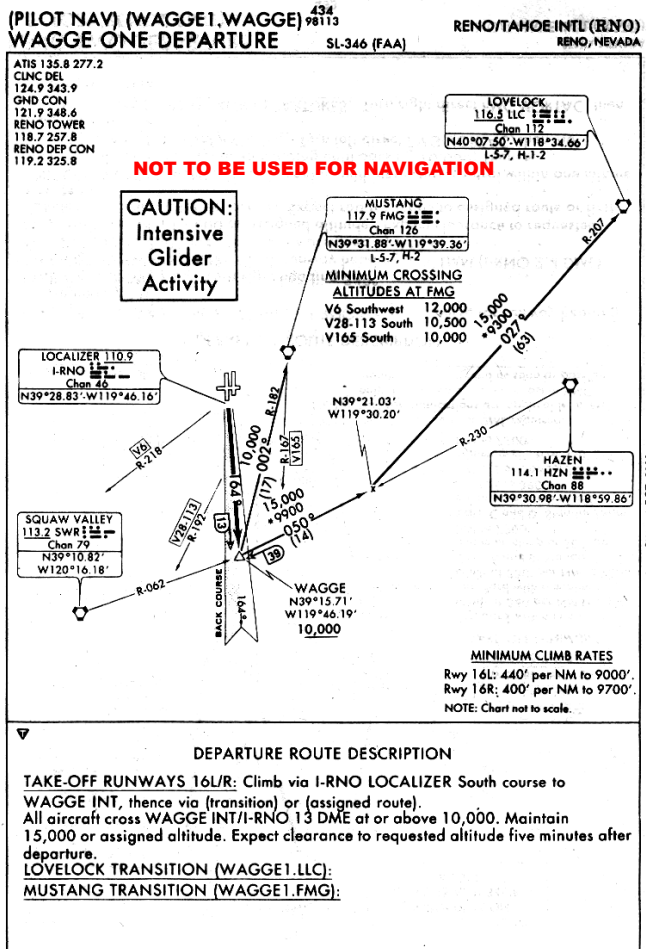
NOTE:

Not all missed approaches end in a holding pattern. Some just end with a straight course segment.



2. The skyway boxes will provide guidance for the holding pattern entry (parallel, teardrop, or direct) and the pattern will be sized according to the procedure speed (V_{PROC}) of YOUR aircraft. Continuation of the hold is at the pilot's discretion. A menu prompt **CONTINUE** will appear if there are additional waypoints further along in the route (such as an alternate). Pressing **CONTINUE** will enable guidance from the holding waypoint to the next waypoint.
3. When leaving the holding pattern to re-fly the same approach, press the **ACTV** button and select the IAF waypoint. To fly another approach at the same airport, press **ACTV**, select the airport, and choose a new approach. Alternately, press the **FPL . .** menu, **NRST** (nearest) button, or **D→** (direct-to) button to enter another destination.

Departure Procedures (DPs)

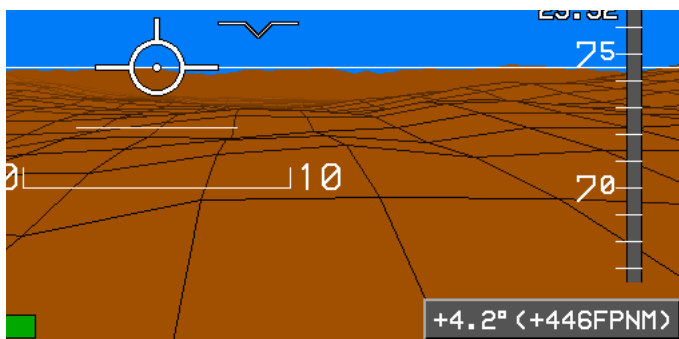


WAGGE ONE DEPARTURE
(PILOT NAV) (WAGGE1.WAGGE) ⁹⁸¹¹³

RENO, NEVADA
RENO/TAHOE INTL (RNO)

A DP is a coded departure route established at busier airports to facilitate clearance delivery procedures. There are two types of DPs: **Pilot Navigation** and **Vector**.

- **Pilot Navigation** – The pilot is primarily responsible for navigation along this kind of route. Terrain and safety-related factors usually call for pilot navigation DPs. These may contain vector instructions that pilots are expected to comply with until resuming normal navigation on the filed route.
 - **Vector** – ATC provides radar navigation guidance to a filed route or to a fixed point depicted on the vector DP charts. Since Vector DPs are based on vectors from ATC, they are not included in the Jeppesen database and are not available in the EFIS.
1. Press the **ACTV** button and use the control knob to select the desired **airport**.
 2. Using the control knob, choose **DP . .** (if **DP . .** is not shown, no pilot nav departure exists for that airport). Using the control knob, select the desired DP, the appropriate transition (if available), and the departure runway.
 3. Set the minimum climb rate from the approach plate (440' per NM for 16L and 400' for 16R in example on the previous page) by pressing the **MENU** button, then **BUGS . .**, then **VNAV CDA . .**, then **CLIMB ANG . .**, then turning and pushing to enter the desired climb angle.



- Before departing, review the DP sequence (by pressing the **ACTV** button) and compare it with the printed plate. Turn the control knob to review each segment of the procedure. Bearing and distance information will be displayed for each waypoint. Press **INFO** to review crossing altitudes. When finished, press **EXIT** to remove menus from the screen.

The departure procedure, transition, and runway will be displayed on the PFD and on the moving map. The active leg will be displayed in magenta.



Course guidance and turn anticipation will be provided on the PFD with skyway boxes and CDI. Skyway boxes will connect waypoints throughout the procedure and will indicate the required climb angle. The CDI will automatically transition from 0.3NM for the first straight leg to 1.0NM for the duration of the DP, finally transitioning to 2.0NM for enroute mode.

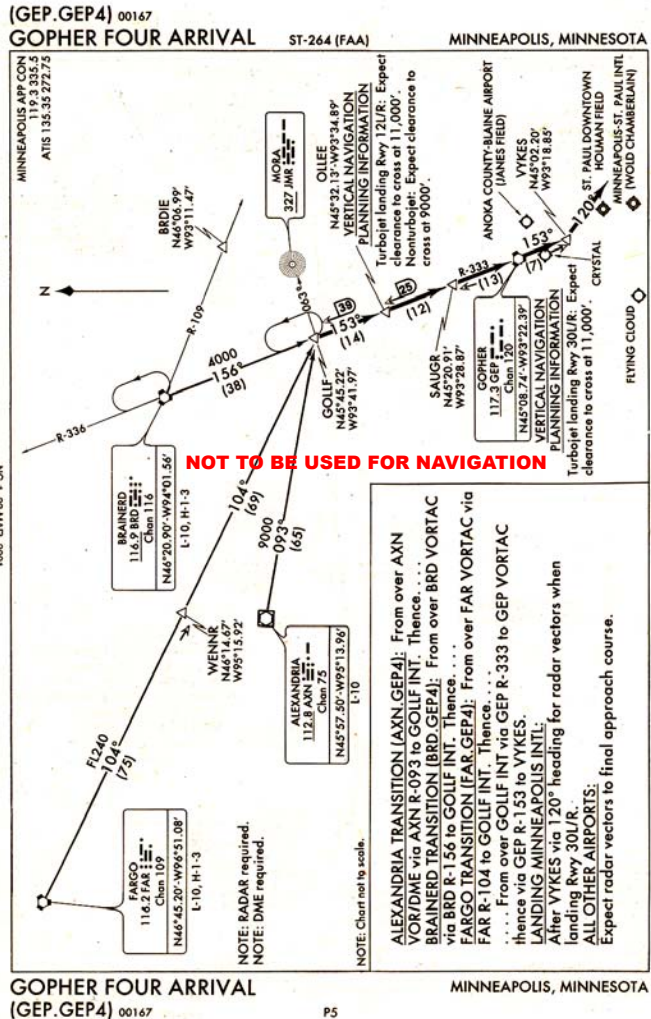
Fly to the active waypoint on the PFD by guiding the flight path marker through the skyway boxes, thereby keeping the CDI needle centered. You may monitor your position along the courseline on the moving map. The active waypoint will

automatically sequence to the next waypoint as the active waypoint is crossed.

DPs normally terminate at an enroute waypoint. As the DP limit is reached, the active waypoint will sequence to the continuation of the active flight plan.

Compare the above screen with the DP plate (WAGGE ONE, Lovelock Transition) on page 7-33. The departure is made to the south to WAGGE intersection, then a left turn to JERGA intersection (shown as a lat/lon and intersecting radials on the plate), the direct to the Lovelock VOR.

Standard Terminal Arrival Routes (STARs)



STARs are ATC coded IFR arrival routes established at busier airports to facilitate arrival and approach procedures. To select and display a STAR:

1. You must have the arrival airport entered as a waypoint (using **NRST**, **Direct-To**, or as part of an active flight plan).
2. Press the **ACTV** button and use the control knob to select the arrival **airport**.
3. Using the control knob, choose **STAR . .** (if **STAR . .** is not shown, no arrival procedure exists for that airport). Using the control knob, select the desired STAR, the appropriate transition (if available), and the anticipated arrival runway.
4. Review the arrival sequence (by pressing the **ACTV** button) and compare it with the printed plate. Turn the control knob to review each segment of the procedure. Bearing and distance information will be displayed for each waypoint. Press **INFO** to review crossing altitudes. When finished, press **EXIT** to remove menus from the screen.

The entire arrival route along with the runway will be displayed on the screens. The active leg will be displayed in magenta on the moving map.

Course guidance and turn anticipation will be provided on the PFD with skyway boxes and CDI. Skyway boxes will connect waypoints throughout the procedure.



Fly to the active waypoint on the PFD by guiding the flight path marker through the skyway boxes, thereby keeping the CDI needle centered. You may monitor your position along the courseline on the moving map. The active waypoint will automatically sequence to the next waypoint as the active waypoint is crossed.

Thirty miles from the destination, course guidance will switch from the enroute mode to the terminal mode and the CDI scale will transition from 2.0 to 1.0NM.

Compare the above screen with the STAR plate (GOPHER FOUR, Alexandria Transition) on **page 7-37**. The arrival is made to the east from the Alexandria VOR (AXN), then southeast through a series of fixes to the Minneapolis-St. Paul International Airport.

STARs normally terminate at a fix near the airport, then a radar vector or feeder route is used for transition to the approach phase. If you activate an IFR approach during the STAR, the approach waypoints will be inserted into the STAR.

Section 8

Appendix

The appendix of this document contains a variety of useful information not covered elsewhere in the manual. In this section you will find emergency/abnormal and normal procedures from the Airplane Flight Manual Supplement, operating tips, system specifications, a detailed description of TAWS functions, warranty information, feedback forms, and more.

Emergency/Abnormal Procedures

Emergency Procedures

PFD Failure

In a primary installation, in the event of a failure of the Primary Flight Display (PFD), the Multifunction Display (MFD) or Standby Instrument (whichever is installed) will be utilized to complete the current flight.

OPTIONAL AUTO-SWITCHING TO BATTERY BUS:

In the event of an electrical power failure, the EFIS will be automatically switched to the aircraft battery bus. The “ON BATT” (yellow) annunciator will illuminate indicating that the EFIS is on the aircraft battery.

OPTIONAL DEDICATED BATTERY INSTALLED:

In the event of an electrical power failure, a dedicated battery will automatically supply electrical power to the EFIS. The “BATT ARM” (white) annunciator will extinguish and the

“BATT ON” (yellow) annunciator will illuminate indicating that the EFIS is on the dedicated battery. The dedicated battery will support the pilot's EFIS for a minimum of one hour.

Abnormal Procedures

Failure of the GPS, AHRS or ADC, singly or in combination, adversely impacts the capabilities of the EFIS. Failure of these components is annunciated visually and audibly. In addition, the EFIS software provides reversionary modes to show as much useful and accurate information as possible in light of the failure condition. See **Failure Modes, page 3-126**.

The following sections detail procedures for reversionary modes:

PFD Failure

In a primary installation, in the event of a failure of the Pilot's/ Co-pilot's Primary Flight Display (PFD) - Press the lower right-hand knob on the Multifunction Display (MFD) to display the primary flight instruments on the MFD.

Pilot's Attitude/Heading Failure

In a primary installation, in the event of the loss of attitude and heading information on the Primary Flight Display (PFD) - Refer to the standby Attitude Instrument for airplane attitude information. The EFIS will continue to display all other functions, including ground track, which may be used in lieu of heading.

GPS Failure

GPS can degrade or fail as a result of loss of satellite information or GPS equipment failure. GPS degradation is annunciated with a “GPS LOI” caution flag and an aural tone to indicate GPS loss of integrity. In this mode, the GPS data loses the WAAS accuracy but remains as accurate as traditional GPS.

Further GPS degradation causes the EFIS to lose GPS updating of aircraft position, ground speed and ground track, and the ability to calculate wind information. A “GPS LON” caution flag is displayed to indicate GPS loss of navigation along with a “GPS failure” voice annunciation.

For more information regarding GPS failure modes, see **GPS Failure, page 3-129**.

In the event of the loss of GPS - Immediately revert to navigation based on dead reckoning and transition to other navigation sources as soon as possible.

In the event of loss of GPS during an IFR approach procedure at or after the final approach fix and still IMC - Initiate the missed approach procedure.

Airdata Failure

In a primary installation, in the event of the loss of air data information (Airspeed and Altitude) on the Primary Flight Display (PFD) - Refer to backup Airspeed and Altitude Instruments.

Auxiliary Sensor Failure

In the event of an auxiliary sensor failure (optional AIU, WX-500 or traffic sensor), refer to the **FAULTS** menu to determine which sensor has failed. In a failure condition, associated symbology is automatically removed from the display. No action is required from the pilot.

With an AIU failure in an installation where the AIU is providing analog guidance signals to an autopilot, the analog guidance signals will be nulled and the autopilot will maintain a wings level attitude and will no longer respond to EFIS guidance. With ARINC429-capable autopilots, ARINC429 roll steering guidance from the EFIS continues to function.

Normal Procedures

Power Up and Self Test

Apply power to the system by applying aircraft power and placing the EFIS Master Switch(s) in the ON position.

System will perform an automatic Self-Test. Passing is indicated by a **“Push any Key to Continue”** screen. At this time, verify that the databases are current. Failure is indicated by a “BIOS error,” “system not found,” blank screen, screen with no image, continual screen resetting (booting) or a “CRC error.”

Operation

Normal operating procedures are outlined in **Step-by-Step Procedures, page 5-1** of this document.

Display Annunciation/Messages

Caution / Warning / Advisory System is outlined in **Caution/Warning/Advisory System, page 2-12** of this document.

System Annunciators/Switching

NOTE:

Actual switches installed are dependent on aircraft configuration

EFIS Master Switch

The optional EFIS Master Switch is a 2-position toggle switch located on the Pilot's instrument panel. Alternately, the EFIS may be connected to the Avionics Master Switch.

“ON BATT” Annunciator

With optional auto-switching to battery bus installed, in the event of an electrical power failure, the EFIS will be automatically switched to the aircraft battery bus. The “ON

BATT” (yellow) annunciator will illuminate indicating that the EFIS is on the aircraft battery.

“BATT ON / BATT ARM” Annunciator

With optional dedicated battery installed, in the event of an electrical power failure, the optional dedicated battery will automatically supply electrical power to the EFIS. The “BATT ARM” (white) annunciator will extinguish and the “BATT ON” (yellow) annunciator will illuminate indicating that the EFIS is on the dedicated battery.

TAWS Inhibit Annunciator/Toggle Switch

The “TAWS INHIBIT” (yellow) annunciator switch, when activated, illuminates and inhibits the visual and audible TAWS alerting functions. The “TAWS INHIBIT” annunciator switch is located near the EFIS displays. This switch may be a toggle switch in which the position of the switch serves as annunciation of activation.

TAWS Caution/Warning

1. Terrain Awareness CAUTION: When a terrain awareness CAUTION occurs, take positive corrective action until the alert ceases. Stop descending or initiate either a climb or a turn, or both, as necessary, based on analysis of all available instruments and information.
2. Terrain Awareness WARNING: If a terrain awareness WARNING occurs, immediately initiate and continue a climb that will provide maximum terrain clearance, or any similar approved vertical terrain escape maneuver, until all alerts cease. Only vertical maneuvers are recommended, unless either operating in visual meteorological conditions (VMC), or the pilot determines, based on all available information, that turning in addition to the vertical escape maneuver is the safest action, or both.

For more information on TAWS, see . and **TAWS Functions, page 8-11.**

Audio Mute Switch

The Audio Mute Switch, located on the Pilot's control wheel or on the instrument panel, mutes EFIS active voice alerts.

Sensor Select Annunciator Switches / Toggle Switches (Dual Sensor Installations Only)

A Sensor Select annunciator switch for each dual sensor installation is located near the pilot's EFIS displays. A separate switch is used for each sensor type (i.e. GPS, ADC, AHRS). In an annunciator switch, the sensor selection is annunciated by illumination of the switch (i.e., GPS 1). This switch may be a toggle switch in which case the up position selects the number 1 sensor and the down position selects the number 2 sensor.

EFIS/AIU Operations with Autopilot Integration

The following discussions relate to using the EFIS to provide guidance signals to the autopilot. All autopilot operations should be performed in accordance with the autopilot user's manual for the system installed in the aircraft.

Heading Mode

There are two methods to operate the EFIS with the autopilot in Heading mode; using the heading bug or using a flight plan following GPS guidance. The Heading Bug is a higher priority than the active flight plan. If the Heading Bug is active, the EFIS will provide guidance based on the Heading Bug. If the Heading Bug is deactivated, the EFIS will provide guidance based on the flight plan.

Heading Bug: Select HDG mode on the autopilot. Press the **HDG** (Heading) button to activate the heading bug. Turn the right knob to select the desired heading and press the knob to activate the heading selection.

To deactivate, Press the **HDG** button followed by the **OFF** menu.

GPS Guidance: Select **HDG** mode on the autopilot. Activate a flight plan. The EFIS will provide guidance to follow the flight plan using GPS WAAS signals. Select **HDG** mode on the autopilot.

Navigation (NAV) Mode

To operate the EFIS with the autopilot in Navigation mode, select the navigation source and the OBS radial. Press the **OBS** button to activate the OBS mode. Use the buttons to select the HSI source to be used: **GPS**, **NAV1**, or **NAV2**. Turn the right knob to select an OBS radial, or to select “Auto” mode and press the knob to activate the selection.

Approach (APPR) Mode

To operate the EFIS with the autopilot in Approach mode, select an appropriate approach. Press the **ACTV** button and turn the right knob to the type of approach (VFR or IFR). Press the knob to select which approach, transition, and runway will be used. Press the **OBS** button and use the buttons to select the HSI source to be used: **GPS**, **NAV1**, or **NAV2**. Follow the approach procedure displayed to fly the approach.

An alternate method if receiving vectors to final is to select the appropriate HSI source: **GPS**, **NAV1**, or **NAV2**. With the autopilot's Approach mode armed, use the Heading Bug to provide heading guidance until the airplane is approaching the extended runway centerline. Turn off the Heading Bug to allow the autopilot to capture and follow the approach navigation guidance.

Operating Tips

After thousands of hours of flying the system, Chelton Flight Systems test pilots have compiled some tips, tricks, and suggestions to help you get the most out of your EFIS.

Descent Planning

Instead of doing time/speed/distance/descent-rate calculations, use the waypoint symbol for descent planning. Simply maintain your cruise altitude until the “X” at the bottom of the waypoint symbol is 2-3 degrees below the horizon (as indicated by the pitch scale), then begin a 2-3 degree descent. Maintain the correct descent angle by keeping the flight path marker positioned on the waypoint “X” symbol. If you use the skyway boxes and set your VNAV descent angle accordingly, this will happen automatically.

Terrain Clearance

Use the flight path marker to evaluate climb performance in regards to terrain clearance. If you are climbing at best angle to clear terrain and the flight path marker on the PFD is overlaying the terrain you are trying to clear, your climb is insufficient and circling will be required. If your flight path marker is well clear of terrain (overlaying blue) your climb is sufficient, but remember that climb performance deteriorates with altitude so monitor your situation closely.

Departure Airport Information

On startup, all the information for the departure airport is readily available; just think “nearest airport info.”

Push the **NRST** button, push the control knob to choose **AIRPORT** (the current airport will be highlighted), then push the **INFO** button. All frequencies and runway data will be displayed.

Pattern Entry

Locating an unfamiliar airport and entering the correct traffic pattern under visual conditions at an unfamiliar airport can be a source of anxiety for any pilot. The Chelton EFIS can make it effortless and foolproof. First, tune into ATIS/ASOS, or obtain an airport advisory 20-30 miles out. Select the runway in use from the **ACTV . .** (select the airport) then **VFR APPR . .** menu. The selected runway will appear light gray on the display with a skyway indicating the final approach path. The runway and touchdown zone elevation will be displayed below the minimap on the PFD.

Unique Names for Flight Plans

Multiple routes between the same airport pairs are numbered automatically (KPSP-KPDX 1, KPSP-KPDX 2, etc.). A little ingenuity will work around this and apply easy-to-remember differentiation. Say you regularly fly an eastern and western route from Palm Springs to Portland, depending on weather or MOA activity. Create two user waypoints at Palm Springs named PSPE and PSPW. Then create two flight plans, one starting with PSPE and one starting with PSPW, both having KPSP as the SECOND waypoint (for activating a DP). Add the individual routes and end both at Portland. If you want to fly the western route, choose PSPW - KPDX. For the eastern route, choose PSPE - KPDX.

Your Instrument Scan

As you become familiar with the system, remember why the Primary Flight Display is called that; it should be used as your primary reference during flight. The PFD page is designed so that your complete instrument scan is a circle with a radius of less than one inch (illustrated below). Combine this “microscan” with an occasional glance at the moving map and you will always be on altitude and on course.



TAWS Functions

General Description:

The Chelton EFIS provides TSO-C151b TAWS functionality. Depending upon aircraft configuration settings and external sensors/switches, the system can be configured as a Class A, B, or C TAWS, or a Class A or B HTAWS. Functions provided by TAWS are:

1. **Terrain Display:** Display of terrain and obstacles on the PFD and ND.
2. **Forward Looking Terrain Awareness (FLTA):** A warning function that uses a terrain database to alert the pilot to hazardous terrain and obstacles in front of the aircraft.
3. **Premature Descent Alert (PDA):** A warning function that alerts the pilot when descending well below a normal approach glidepath on the final approach segment of an instrument approach procedure.
4. **Excessive Rate of Descent (GPWS Mode 1):** A warning function that alerts the pilot when the rate of descent is hazardously high as compared to height above terrain (i.e., descending into terrain).
5. **Excessive Closure Rate to Terrain (GPWS Mode 2):** A warning function that alerts the pilot when the rate of change of height above terrain is hazardously high as compared to height above terrain (i.e., flying level over rising terrain).
6. **Sink Rate after Takeoff or Missed Approach (GPWS Mode 3):** A warning function that alerts the pilot when a sink rate is detected immediately after takeoff or initiation of a missed approach.
7. **Flight into Terrain when not in Landing Configuration (GPWS Mode 4):** A warning function that alerts the pilot when descending into terrain without properly configuring the aircraft for landing.

8. 8.Excessive Downward Deviation from an ILS Glideslope (GPWS Mode 5): A warning function that alerts the pilot when an excessive downward glideslope deviation is detected on the final approach segment of an ILS approach.
9. 9.500 foot Wake-up Call: A single voice callout when descending through 500 feet AGL.

TAWS functions provided by the EFIS as compared to TAWS/HTAWS class and aircraft type are as follows:

Aircraft Type	TAWS Class	Terrain Display	FLTA	PDA	GPWS Mode 1	GPWS Mode 2	GPWS Mode 3	GPWS Mode 4	GPWS Mode 5	500' Call
Airplane RG + F	A	X	X	X	X	X	X	X	X	X
Airplane RG	A	X	X	X	X	X	X	X	X	X
Airplane FG + F	A	X	X	X	X	X	X	X	X	X
Airplane FG	A	X	X	X	X	X	X		X	X
Rotorcraft RG	A	X	X		X	X	X	X	X	
Rotorcraft FG	A	X	X		X	X	X		X	
Airplane	B or C	X	X	X	X		X			X
Rotorcraft	B	X	X				X			

Notes:RG + F = Retractable Gear with Defined Landing Flaps Position

RG= Retractable Gear

FG + F= Fixed Gear with Defined Landing Flaps Position

FG= Fixed Gear

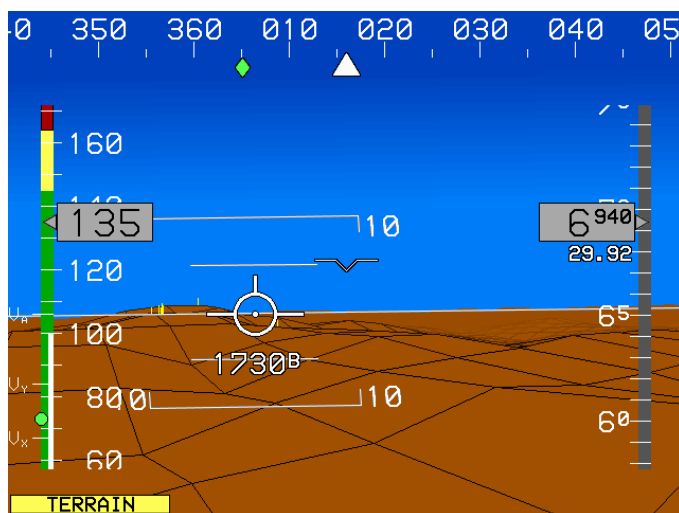
Detailed operations of the TAWS functions are described in the following sections.

Terrain Display:

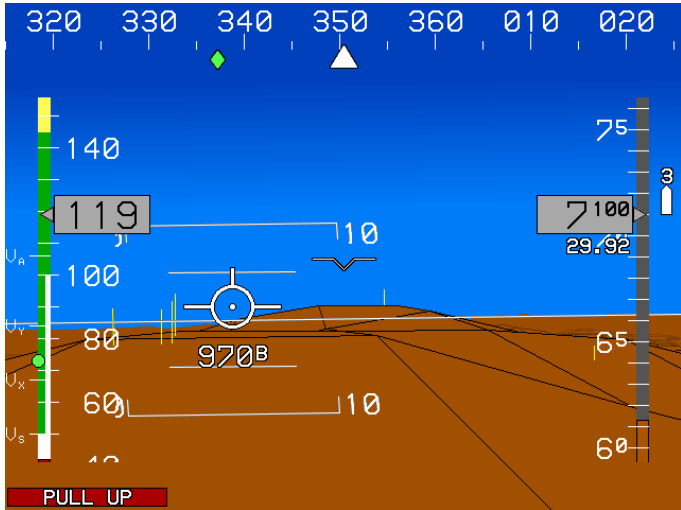
This function is present in all systems. The Terrain Display function uses a terrain database, aircraft position, aircraft heading or track, aircraft attitude, and aircraft altitude to render a display of surrounding terrain and obstacles on the primary flight display and navigation display.

Terrain is displayed on the primary flight display using a perspective fishnet style rendering. Terrain color is brown with the fishnet color fading from black to brown to impart atmospheric perspective. In addition, the sky color changes from a light blue at the horizon to a darker blue above the horizon for additional atmospheric perspective effect. The relative elevation of terrain

with respect to aircraft altitude and performance is naturally observed by reference to the primary flight display pitch ladder and flight path marker. Obstacles are shown on the primary flight display as simple yellow lines, and look very much like radio towers. The following screen captures show terrain and obstacles on the primary flight display:



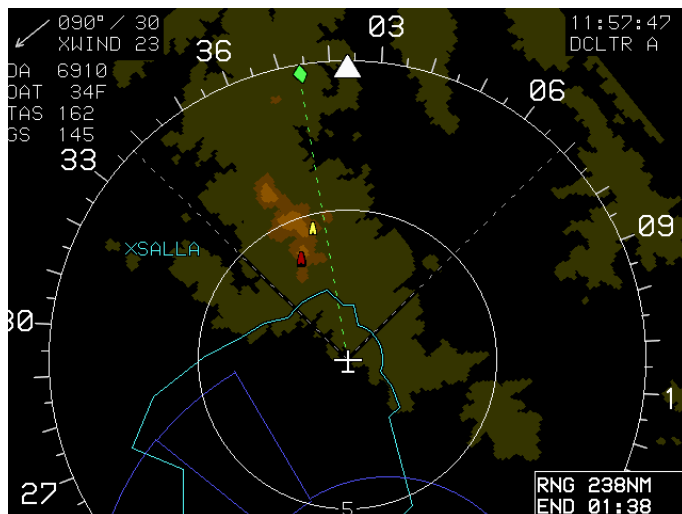
Above: TAWS Caution on PFD.



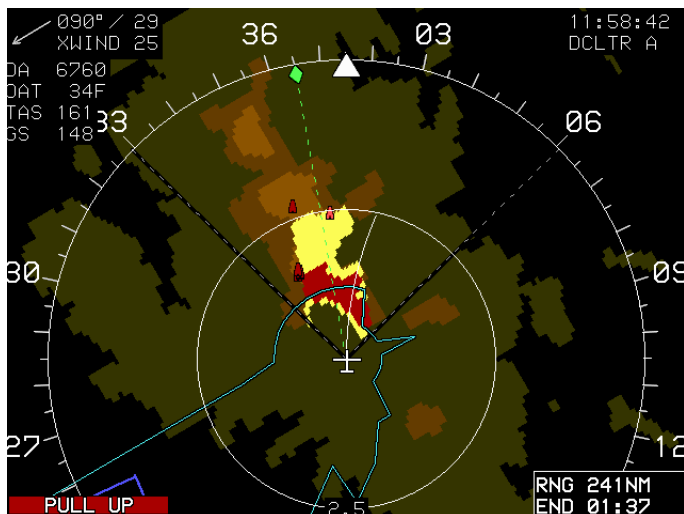
Above: TAWS warning on PFD.

Terrain and obstacles are displayed on the navigation display using colors to show relationship to aircraft altitude. Terrain areas are colored black when more than 2000 feet below aircraft altitude; dark olive when within 2000 feet but more than 500 feet below aircraft altitude; dark brown when within 500 feet but below aircraft altitude; and light brown when at or above aircraft altitude. Deep blue denotes areas of water and takes precedence over other colors. Obstruction symbols are colored yellow when within 2000 feet but more than 500 feet below aircraft altitude; light red when within 500 feet but below aircraft altitude; and deep red when at or above aircraft altitude. The colors green, yellow and red are not used for normal display of terrain because: (1) such usage would conflict with the meanings attributed to these colors by the FAR's; and (2) these are customarily used on electronic displays to show weather and could lead to pilot confusion when both terrain and weather are shown on the

navigation display. yellow and red are used to show terrain areas causing an FLTA alert as further described in the FLTA section below. Such coloration complies with the requirement that terrain elements causing an FLTA alert be distinguishable from those that do not. The following screen capture shows terrain and obstructions on the navigation display:



Above: Obstructions and non-threatening terrain on the moving map; no TAWS warning.



Above: Threatening terrain on the moving map generating a TAWS warning.

The Terrain Display function can be manually inhibited by the pilot for decluttering. In addition, under certain failure conditions, the Terrain Display function is automatically inhibited. When the Terrain Display function is inhibited, the primary flight display background changes to a solid blue over brown presentation without a fishnet or atmospheric perspective. This makes it clear to the pilot that terrain is not being displayed and obviates the need for an annunciation on the primary flight display. On the navigation display, the word TERRAIN with an X over the top is displayed in the upper right hand corner. If the Terrain Display function is manually disabled, the X will be green. If the Terrain Display function is automatically disabled due to an abnormal condition, the X will be red.

Forward Looking Terrain Alert Function:

The EFIS FLTA mode is either slaved to the GPS/WAAS navigation mode or set automatically based upon default mode logic. Mode selection is described as follows:

GPS/WAAS Navigation Mode Slaving

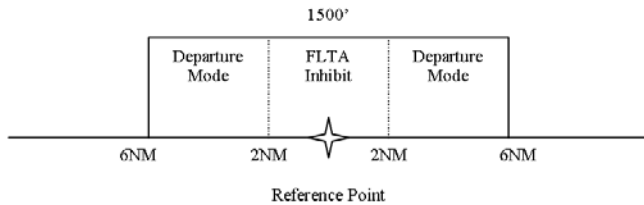
The EFIS performs TSO-C146a GPS/WAAS system functions in addition to the TAWS functions. As a result, GPS/WAAS navigation mode is available as an input to the TAWS. In accordance with RTCA/DO-229C, the user can select an IFR procedure (Approach, DP, or STAR) that automatically changes the GPS/WAAS navigation mode to Enroute, Terminal, Departure, or IFR Approach as appropriate. In addition, the EFIS allows the user to select a VFR approach to any runway or user waypoint with a defined approach path. Selection of a VFR approach causes automatic GPS/WAAS navigation mode changes to Enroute, Terminal or VFR Approach as appropriate. If the GPS/WAAS navigation mode is higher in precedence than the default FLTA mode, the FLTA mode is slaved to the GPS/WAAS navigation mode. The order of precedence is: (1) Departure Mode; (2) Approach Mode (IFR or VFR); (3) Terminal Mode; and (4) Enroute Mode. When slaved, the GPS/WAAS active runway threshold or user waypoint will be the reference point for automatic FLTA inhibiting. The advantage of this methodology is that the GPS/WAAS navigation modes are a direct indication to the FLTA function of pilot intent. Thus, it provides a mechanism for helicopter or bush pilots to desensitize the TAWS when conducting normal off-runway operations.

Default FLTA Mode

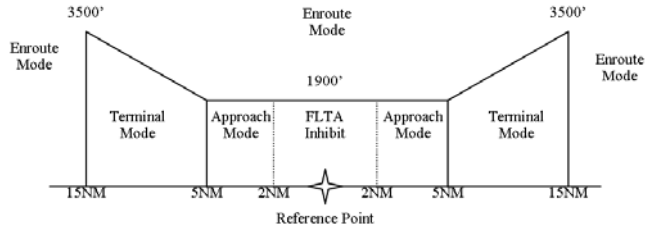
If the default FLTA navigation mode is higher in precedence than the GPS/WAAS navigation mode, the FLTA mode will be slaved to the default FLTA navigation mode. The order of precedence is: (1) Departure Mode; (2) Approach Mode; (3) Terminal Mode; and (4) Enroute Mode. These modes are as follows:

1. Departure Mode. This mode is enabled when on the ground (defined as indicated airspeed less than or equal to V_s AND AGL altitude less than 75 feet). The reference point for automatic FLTA inhibiting and mode envelope definition is the last point at which the ground

definition was satisfied (this will be near the liftoff point). The Departure Mode will end upon climbing through 1,500 feet above or traveling more than 6NM from the reference point.



2. Other Modes. For other default FLTA modes, the reference point for automatic FLTA inhibiting and mode envelope definition will be the nearest runway threshold. The TAWS continuously searches all runway thresholds at the nearest airport to determine the nearest runway. The TAWS performs a search for the nearest airport every 3NM of distance traveled. Modes are as follows:
 - a. Approach Mode. This mode exists when within 1,900 feet and 5.0NM of the reference point.
 - b. Terminal Mode. This mode exists from 5NM to 15NM from the reference point when below an altitude that varies from 1,900 feet (at 5NM) to 3,500 feet (at 15NM) above the reference point.
 - c. Enroute Mode. This mode exists when not in any other mode.



FLTA Search Envelope:

The FLTA search envelope is an area in front of and below the aircraft. If terrain or an obstruction is found within the FLTA search envelope, a caution or warning is given to the pilot. The dimensions of the search envelope depend on TAWS type, FLTA mode (described above), aircraft groundspeed, aircraft bank angle and aircraft vertical speed. Basic envelope parameters are as follows:

1. TAWS Type: The TAWS type determines the value of several parameters used to calculate the search envelope. These parameters are described below:
 - a. Level-Off Rule: This parameter is the value, in percent of vertical speed, used to determine level-off leading for the descending flight Reduced Required Terrain Clearance (RTC) calculation. For airplanes, this value is set to 20% for Class A and B TAWS, and 10% for Class C TAWS. For rotorcraft, this value is set to 10%.
 - b. Range: This parameter is the forward range of the search envelope in seconds. For airplanes, this value is set to 60 seconds. For rotorcraft, this value is set to 30 seconds and is reduced to 20 seconds when Low Altitude Mode is

- engaged.
- c. Enroute Mode Level / Climbing Flight RTC:
This parameter is the Enroute Mode level or climbing flight RTC in feet. For airplanes, this value is set to 700 feet for Class A and B TAWS, and 250 feet for Class C TAWS. For rotorcraft, this value is set to 150 feet and is reduced to 100 feet when Low Altitude Mode is engaged.
 - d. Terminal Mode Level / Climbing Flight RTC:
This parameter is the Terminal Mode level or climbing flight RTC in feet. For airplanes, this value is set to 350 feet for Class A and B TAWS, and 250 feet for Class C TAWS. For rotorcraft, this value is set to 150 feet and is reduced to 100 feet when Low Altitude Mode is engaged.
 - e. Approach Mode Level / Climbing Flight RTC:
This parameter is the Approach Mode level or climbing flight RTC in feet. For airplanes, this value is set to 150 feet. For rotorcraft, this value is set to 150 feet and is reduced to 100 feet when Low Altitude Mode is engaged.
 - f. Departure Mode Level / Climbing Flight RTC: This parameter is the Departure Mode level or climbing flight RTC in feet. This value is set to 100 feet for all TAWS classes for both airplanes and rotorcraft.
 - g. Enroute Mode Descending RTC: This parameter is the Enroute Mode descending flight RTC in feet. For airplanes, this value is set to 500 feet for Class A and B TAWS, and 200

feet for Class C TAWS. For rotorcraft, this value is set to 100 feet.

- h. Terminal Mode Descending RTC: This parameter is the Terminal Mode descending flight RTC in feet. For airplanes, this value is set to 300 feet for Class A and B TAWS, and 200 feet for Class C TAWS. For rotorcraft, this value is set to 100 feet.
- i. Approach Mode Descending RTC: This parameter is the Approach Mode descending flight RTC in feet. This value is set to 100 feet for all TAWS classes for both airplanes and rotorcraft.
- j. Departure Mode Descending RTC: This parameter is the Departure Mode descending flight RTC in feet. This value is set to 100 feet for all TAWS classes for both airplanes and rotorcraft.

TAWS type parameters are summarized in the following table:

Aircraft Type	TAWS Class	Level Off Rule	Range	Level RTC				Descending RTC			
				Enroute	Terminal	Approach	Departure	Enroute	Terminal	Approach	Departure
Airplane	A & B	20%	60sec	700'	350'	150'	100'	500'	300'	100'	100'
	C	10%		250'	250'			200'	200'		
Rotorcraft	A & B	10%	30sec	150'	150'	150'	100'	100'	100'	100'	100'
Rotorcraft (Low Alt)	A & B	10%	20sec	100'	100'	100'	100'	100'	100'	100'	100'

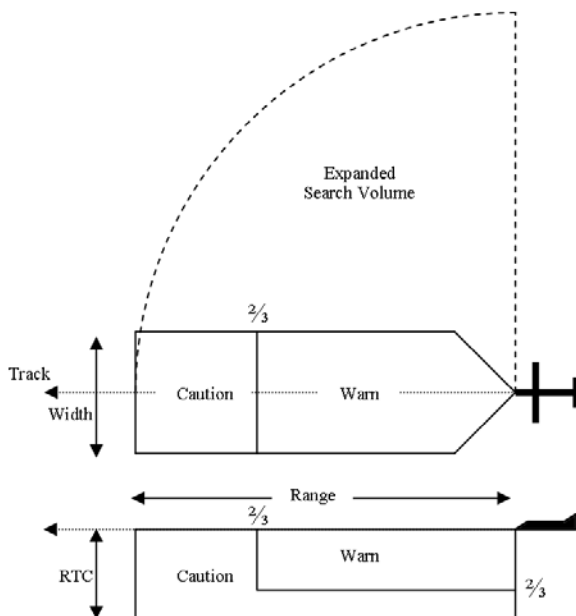
2. Aircraft Track: The terrain search envelope is aligned with aircraft track.
3. Aircraft Groundspeed: Aircraft groundspeed is used in conjunction with the range parameter to determine the look-ahead distance. In addition, aircraft groundspeed is used in conjunction with FLTA mode to determine

the search volume width as follows:

- a. Enroute Mode: Search volume width is based upon a 30° change in track followed by 30 seconds of flight at aircraft groundspeed. Maximum width is 0.5NM either side of track.
 - b. Terminal Mode: Search volume width is based upon a 15° change in track followed by 30 seconds of flight at aircraft groundspeed. Maximum width is 0.4NM either side of track.
 - c. Approach Mode: Search volume width is based upon a 10° change in track followed by 30 seconds of flight at aircraft groundspeed. Maximum width is 0.3NM either side of track.
 - d. Departure Mode: Search volume width is based upon a 10° change in track followed by 30 seconds of flight at aircraft groundspeed. Maximum width is 0.3NM either side of track.
4. Aircraft Bank Angle: Aircraft bank angle is used to expand the search volume in the direction of a turn. Search volume expansion requires at least 10 of bank. In addition, search volume expansion is debounced such that at 10° of bank, the bank angle must be continuously held for 3.25 seconds. The amount of debouncing is reduced linearly with increased bank angle such that at 30° of bank, there is no debounce time. Debouncing is intended to reduce nuisance search volume expansions when experiencing bank angle excursions due to turbulence.
 5. Aircraft Vertical Speed: Aircraft vertical speed is used to determine which RTC values should be used. At vertical speeds above -500fpm, level and climbing flight RTC values are used. At vertical speeds less than or

equal to -500fpm, descending flight RTC values are used. In addition, vertical speed is used to increase the descending flight RTC value used by the system. The increase in descending flight RTC is based upon a 3 second pilot reaction time and VSI leading according to the level-off rule parameter.

FLTA search volume is depicted below:



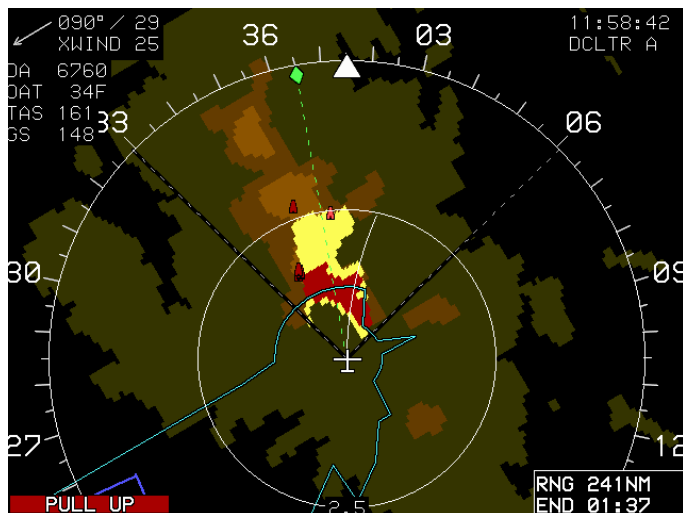
FLTA Alerts and Automatic Popup:

When terrain falls within the FLTA search envelope an FLTA warning is generated as described in **Caution/Warning/Advisory System, page 2-12**. In addition, an automatic popup mode will be engaged as follows:

Primary Flight Display	Multi-Function Display
Terrain rendering enabled.	<ol style="list-style-type: none"> 1. Display switched to navigation display. 2. Terrain rendering enabled. 3. Display switched to aircraft centered and heading up. 4. Scale set to 5NM (groundspeed < 200 knots) or 10NM (groundspeed > 200 knots). 5. Terrain elements generating cautions are colored amber. 6. Terrain elements generating warnings are colored red.

After the popup mode is engaged, the pilot can manually change any setting that was automatically changed by the popup mode.

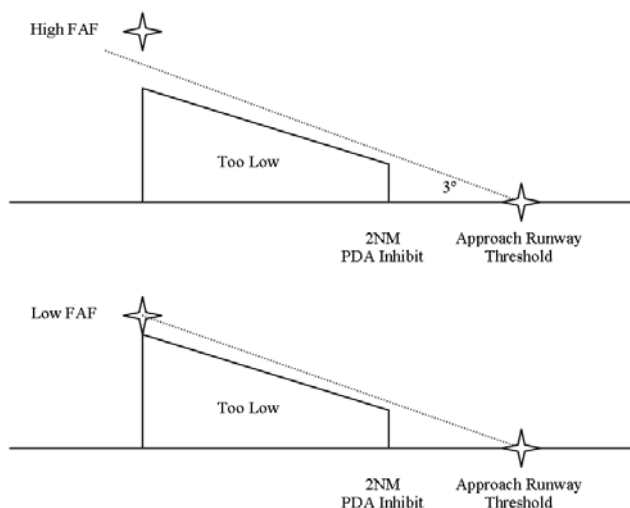
The following screen capture shows the multi-function display in popup mode:



Premature Descent Alert Function:

This function applies to airplane TAWS systems. The PDA function uses the GPS/WAAS navigation database, GPS/WAAS navigation mode, aircraft position, and aircraft altitude to alert the pilot when descending well below a normal approach glide path on the final approach segment of an instrument approach procedure.

The PDA function is armed when on the final approach segment of an IFR approach procedure and below the FAF crossing altitude. The alerting threshold for the PDA function is 0.5° less than the lower of: (1) a straight line from the FAF to the approach runway threshold; or (2) 3° . When the aircraft descends below the threshold, an yellow TOO LOW caution flag is presented in conjunction with a single Too Low Terrain voice alert. The PDA alert threshold is depicted below:



Excessive Rate of Descent (GPWS Mode 1):

This function is present in all airplane TAWS systems and rotorcraft Class A HTAWS. The GPWS Mode 1 function uses aircraft vertical speed information and AGL altitude to alert the pilot when the rate of descent is hazardously high as compared to height above terrain.

GPWS Mode 1 has a caution threshold and a warning threshold. When below the warning threshold, a red PULL UP warning flag is presented in conjunction with a repeating Pull Up, Pull Up voice alert. When above the warning threshold but below the caution threshold, an yellow SINK RATE caution flag is presented in conjunction with a single Sink Rate voice alert. The system uses RTCA/DO-161A Mode 1, Envelope 1 for TAWS systems, and a similar curve modified for helicopter operations for HTAWS systems.

Excessive Closure Rate to Terrain (GPWS Mode 2):

This function is present in Class A TAWS and HTAWS systems. The GPWS Mode 2 function uses filtered AGL rate and AGL altitude to alert the pilot when the rate of change of height above terrain is hazardously high as compared to height above terrain (i.e., flying level over rising terrain). AGL rate filtering is based upon a sampling distance that varies with AGL altitude. Sampling distance varies from 0.5NM at 0' AGL to 0.2NM at 2,500' AGL.

There are two Mode 2 envelopes: Mode 2A which is active when not in landing configuration; and Mode 2B which is active when in landing configuration. Envelope selection is determined as follows:

Aircraft Type	Mode 2A	Mode 2B
Airplane RG + F	Flaps NOT in landing configuration.	Flaps in landing configuration.
Airplane RG	Landing Gear UP	Landing Gear DOWN
Airplane FG + F	Flaps NOT in landing configuration	Flaps in landing configuration
Airplane FG	AGL Altitude > 500' OR IAS > Note 1	AGL Altitude < 500' AND IAS < Note 1
Rotorcraft RG	Landing Gear UP	Landing Gear DOWN
Rotorcraft FG	AGL Altitude > 200' OR IAS > 80KIAS	AGL Altitude < 200' AND IAS < 80KIAS

Notes: RG + F = Retractable Gear with Defined Landing Flaps Position

RG = Retractable Gear

FG + F = Fixed Gear with Defined Landing Flaps Position

FG = Fixed Gear

1. Normal Landing Pattern Speed + 15KIAS

When the GPWS Mode 2 envelope is pierced, a GPWS Mode 2 warning is generated as described in **Caution/Warning/Advisory System, page 2-12**. Envelopes are defined below:

Mode 2A (NOT in Landing Configuration):

The system uses the RTCA/DO-161A Mode 2A envelope for TAWS systems, and a similar curve modified for helicopter operations for HTAWS. The upper limit of the curves includes an airspeed expansion function.

Mode 2B (Landing Configuration):

The system uses the RTCA/DO-161A Mode 2B envelope for TAWS systems, and a similar curve modified for helicopter operations for HTAWS systems.

Sink Rate after Takeoff or Missed Approach (GPWS Mode 3):

This function is present in all TAWS and HTAWS classes. The GPWS Mode 3 function uses aircraft vertical speed information and AGL altitude to alert the pilot when a sink rate is detected immediately after takeoff or initiation of a missed approach.

GPWS Mode 3 is armed by either being on the ground (defined as indicated airspeed less than V_s (airplanes) / 40KIAS (rotorcraft) AND AGL altitude less than 75 feet) or by being on the first leg of a missed approach procedure (as determined by the EFIS FMS) with distance to the active runway threshold increasing. GPWS Mode 3 is disarmed upon climbing through 700 feet AGL, traveling more than 6NM from the last point at which the ground definition was satisfied (this will be near the liftoff point), or transitioning to the second leg of a missed approach procedure. GPWS Mode 3 has a caution threshold based upon height above terrain and vertical speed. When below the caution threshold, a GPWS Mode 3 warning is generated as described in **Caution/Warning/Advisory System, page 2-12**

Flight into Terrain when not in Landing Configuration (GPWS Mode 4):

This function is present in Class A TAWS and HTAWS. The GPWS Mode 4 function uses aircraft speed information and AGL altitude to alert the pilot when descending into terrain without properly configuring the aircraft for landing. There are two Mode 4 envelopes: Mode 4A which gives cautions when landing gear is in other than landing configuration; and Mode 4B

which gives cautions when landing gear or flaps are in other than landing configuration. Applicability of Mode 4 envelopes to aircraft types is as follows:

Aircraft Type	Mode 4A	Mode 4B
Airplane RG + F	Landing Gear UP	Landing Gear UP OR Flaps not in landing configuration.
Airplane RG	Landing Gear UP	Landing Gear UP
Airplane FG + F	Not Applicable	Flaps not in landing configuration
Airplane FG	Not Applicable	Not Applicable
Rotorcraft RG	Landing Gear UP	Not Applicable
Rotorcraft FG	Not Applicable	Not Applicable

Notes: RG + F = Retractable Gear with Defined Landing Flaps Position
 RG = Retractable Gear
 FG + F = Fixed Gear with Defined Landing Flaps Position
 FG = Fixed Gear

Mode 4 alerting criteria require that the Mode 4 envelope be entered from above. Changing aircraft configuration while within a Mode 4 envelope will not generate an alert.

Airplane Mode 4 envelopes consist of a low-speed region and a high-speed region. When Mode 4A alerting criteria is met in the low-speed region, an yellow TOO LOW caution flag is presented in conjunction with a single Too Low Gear voice alert. When Mode 4B alerting criteria is met in the low-speed region, an yellow TOO LOW caution flag is presented in conjunction with either a single Too Low Gear voice alert (if landing gear is UP) or a single Too Low Flaps voice alert (if landing gear is DOWN). When either Mode 4 alerting criteria is met in the high-speed region, an yellow TOO LOW caution flag is presented in conjunction with a single Too Low Terrain voice alert.

The rotorcraft Mode 4 envelope also consists of a low-speed region and a high-speed region. In the low-speed region, an yellow TOO LOW caution flag is presented in conjunction with a single Too Low Gear voice alert. In the high-speed region, an

yellow TOO LOW caution flag is presented in conjunction with a single Too Low Terrain voice alert. In addition, the rotorcraft Mode 4 features autorotation expansion. When autorotation expansion is engaged, the voice alert is Too Low Gear regardless of speed.

The system uses RTCA/DO-161A Mode 4 Envelope 3 for TAWS systems, and a similar curve modified for helicopter operations for HTAWS systems.

Excessive Downward Deviation from an ILS Glideslope (GPWS Mode 5):

This function is present in Class A TAWS and HTAWS systems. The GPWS Mode 5 function uses ILS glideslope deviation information and AGL altitude to alert the pilot when an excessive downward glideslope deviation is detected on the final approach segment of an ILS approach. GPWS Mode 5 is armed when a valid glideslope signal is being received AND the aircraft's 5 second filtered descending glide path is greater than 1° AND the aircraft is below 1,000' AGL.

GPWS Mode 5 has a caution threshold and a warning threshold. When below the warning threshold, a red GLIDESLOPE warning flag is presented in conjunction with a repeating Glide Slope voice alert. When above the warning threshold but below the caution threshold, an yellow GLIDESLOPE caution flag is presented in conjunction with a single Glideslope voice alert. The system uses RTCA/DO-161A Mode 5 for TAWS and HTAWS.

500-Foot Wake-Up Call:

This function is present in all TAWS classes. The 500-foot function includes an arming deadband of 500 feet to prevent nuisance warnings during low altitude operations. Thus, the aircraft must

climb above 1,000 feet AGL to arm the 500-foot function. Once armed, the 500-foot function works by simply issuing a “Five Hundred” voice alert when descending through 500 feet AGL.

External Sensors and Switches:

The EFIS TAWS system requires a variety of inputs from external sensors and switches to perform its functions. These inputs are summarized below:

1. GPS/WAAS receiver. The GPS/WAAS receiver is the source of aircraft position, geodetic height, horizontal figure of merit, vertical figure of merit, loss of integrity and loss of navigation inputs for the TAWS. The GPS/WAAS receiver connects directly to the EFIS IDU.
2. Air Data Computer. The air data computer is the source of barometric altitude, outside air temperature, and vertical speed for the TAWS. The air data computer connects directly to the EFIS IDU.
3. ILS Receiver. An ILS receiver is the source of glideslope deviation for the TAWS. The glideslope receiver connects to an external signal conversion box that communicates digitally with the EFIS IDU.
4. Radar Altimeter. A radar altimeter is the source for radar altitude for the TAWS. The radar altimeter connects to an external signal conversion box that communicates digitally with the EFIS IDU.
5. Gear Position Sensors. Three individual landing gear position discretes are the source of landing gear position for the TAWS. The landing gear position discretes are of the pull-to-ground type and connect directly to the EFIS IDU. Each discrete is grounded when the landing gear to which it is connected is down and locked.

6. Flap Position Sensor. A flap position discrete is the source of flap position for the TAWS. The flap position discrete is of the pull-to-ground type and connects to an external signal conversion box that communicates digitally with the EFIS IDU. The flap position discrete is grounded when the flaps are in the landing configuration.
7. TAWS Inhibit Switch. A TAWS Inhibit Switch is used for manual inhibiting of TAWS alerting functions. The TAWS Inhibit Switch is of the latching type and gives an obvious indication of actuation (i.e., toggle / rocker or pushbutton with indicator light). The TAWS Inhibit Switch is connected directly to the EFIS IDU. The TAWS Inhibit Switch is activated when manual inhibiting of TAWS alerting functions is desired.
8. Low Altitude Mode Switch. A Low Altitude Mode Switch is used for inhibiting and modifying HTAWS alerting functions to allow normal operation at low altitudes. The Low Altitude Mode Switch is of the latching type and gives an obvious indication of actuation (i.e., toggle / rocker or pushbutton with indicator light). The Low Altitude Mode Switch is connected directly to the EFIS IDU. The Low Altitude Mode Switch is activated when operation in Low Altitude Mode is desired.
9. Audio Cancel Switch. An Audio Cancel Switch is used for silencing active voice alerts. The Audio Cancel Switch is of the momentary type. The Audio Cancel Switch is connected directly to the EFIS IDU. The Audio Cancel Switch is momentarily depressed when silencing of active voice alerts is desired.
10. Glideslope Deactivate Switch. A Glideslope Deactivate Switch is used for inhibiting the GPWS Mode 5

function. The Glideslope Deactivate Switch is of the momentary type. The Glideslope Deactivate Switch connects to an external signal conversion box that communicates digitally with the EFIS IDU. The Glideslope Deactivate Switch is momentarily depressed when inhibition of the GPWS Mode 5 function is desired.

11. Low Torque Sensor. A low torque discrete is used for inhibiting and modifying HTAWS alerting functions during an autorotation. The low torque discrete is of the pull-to-ground type and connects to an external signal conversion box that communicates digitally with the EFIS IDU. The low torque discrete detects when engine torque is less than 7.5%.

The following tables list the applicability of external sensors and switches for various aircraft and TAWS system types:

Sensors/Switches Connected Directly to IDU							
Aircraft Type	TAWS/ HTAWS Class	GPS/WAAS	ADC	Gear Position Sensor	TAWS Inhibit Switch	Audio Cancel Switch	Low Altitude Mode Switch
Airplane RG + F	A	X	X	X	X	X	
Airplane RG	A	X	X	X	X	X	
Airplane FG + F	A	X	X		X	X	
Airplane FG	A	X	X		X	X	
Rotorcraft RG	A	X	X	X	X	X	X
Rotorcraft FG	A	X	X		X	X	X
Airplane	B or C	X	X		X	X	
Rotorcraft	B	X	X		X	X	X

Sensors/Switches Connected to External Signal Conversion Box						
Aircraft Type	TAWS/ HTAWS Class	ILS	Radar Altimeter	Flap Position Sensor	Glideslope Deactivate Switch	Low Torque Sensor
Airplane RG + F	A	X	X	X	X	
Airplane RG	A	X	X		X	
Airplane FG + F	A	X	X	X	X	
Airplane FG	A	X	X		X	
Rotorcraft RG	A	X	X		X	X
Rotorcraft FG	A	X	X		X	X
Airplane	B or C					
Rotorcraft	B					

Notes: RG + F = Retractable Gear with Defined Landing Flaps Position
RG = Retractable Gear
FG + F = Fixed Gear with Defined Landing Flaps Position
FG = Fixed Gear

TAWS Basic Parameter Determination:

The fundamental parameters used for TAWS system functions are: (a) aircraft position, groundspeed, and track; (b) MSL altitude; (c) terrain data; (d) obstacle data; (e) AGL altitude; (f) vertical speed; (g) terrain closure rate; and (h) runway/reference point location. There are redundant sources for some of these parameters. These parameters are acquired for use by the EFIS as follows:

1. Aircraft position, groundspeed and track. Aircraft position, groundspeed and track come solely from the GPS/WAAS. In order to be considered valid for use by the TAWS, the following conditions must be met:
 - a. There is no GPS/WAAS loss of integrity caution;
 - b. There is no GPS/WAAS loss of navigation caution; and
 - c. GPS/WAAS horizontal figure of merit (HFOM) is less than or equal to 0.3NM.
2. MSL altitude. The primary source for MSL altitude is GPS/WAAS geodetic height. In order for GPS/WAAS geodetic height to be considered valid for use as MSL altitude, the following conditions must be met:
 - a. There is no GPS/WAAS loss of integrity caution;
 - b. There is no GPS/WAAS loss of navigation caution; and
 - c. GPS/WAAS vertical figure of merit (VFOM) is less than or equal to 75 feet.

The secondary source of MSL altitude is temperature corrected barometric altitude from an air data

computer.

3. Terrain data. The sole source for terrain data is a terrain database. In order for terrain data to be considered valid for use by the TAWS, the following conditions must be met:
 - a. Aircraft position is valid;
 - b. Aircraft position is within the boundaries of the terrain database; and
 - c. The terrain database is not corrupt as determined by a CRC-32 check at system initialization.
4. Obstacle data. The sole source for obstacle data is an obstacle database. In order for obstacle data to be considered valid for use by the TAWS, the following conditions must be met:
 - a. Aircraft position is valid;
 - b. Aircraft position is within the boundaries of the obstacle database; and
 - c. The obstacle database is not corrupt as determined by a CRC-32 check at system initialization.

Note that obstacle data is only used for depicting obstacles. It is not used for warning functions.

5. AGL altitude. The primary source for AGL altitude is radar altitude. The secondary source for AGL altitude is MSL altitude less terrain altitude.
6. Vertical speed. The primary source for vertical speed is barometric vertical speed from an air data computer. The secondary source for vertical speed is GPS/WAAS vertical speed. In order for GPS/WAAS vertical speed to be considered valid, the following conditions must be met:

- a. There is no GPS/WAAS loss of integrity caution;
 - b. There is no GPS/WAAS loss of navigation caution; and
 - c. GPS/WAAS vertical figure of merit is less than or equal to 75 feet.
7. Terrain closure rate. The source for terrain closure rate is the smoothed first derivative of AGL altitude. As there are multiple sources for AGL altitude, there are multiple sources for terrain closure rate. The smoothing algorithm is described in the GPWS Mode 2 section.
8. Runway/reference point location. The runway or reference point location used by the TAWS algorithms is determined from the EFIS navigation database. In order to be considered valid for use, the following conditions must be met:
 - a. Aircraft position is valid;
 - b. Aircraft position is within the boundaries of the navigation database; and
 - c. The navigation database is not corrupt as determined by a CRC-32 check at system initialization.

TAWS Automatic Inhibit Functions (Normal Operation):

The following automatic inhibit functions occur during normal TAWS operation to prevent nuisance warnings:

1. The FLTA function is automatically inhibited when in the Terminal, Departure, IFR Approach or VFR Approach Modes and within 2NM of the reference point.
2. The PDA function is automatically inhibited when within 2NM of the approach runway threshold.

3. GPWS Modes 1 through 5 are automatically inhibited when below 50 feet AGL (radar altimeter AGL altitude) or below 100 feet AGL (terrain database AGL altitude).
4. GPWS Mode 4 is inhibited while Mode 3 is armed.

As these inhibit modes are part of normal TAWS operation, no annunciation is given when they are engaged.

TAWS Automatic Inhibit Functions (Abnormal Operation):
The following automatic inhibit functions occur during the specified abnormal operations:

1. Autorotation detection. When engine torque drops below 7.5%, a Class A HTAWS system enters Autorotation Mode. In this mode:
 - a. GPWS Mode 1 is inhibited;
 - b. GPWS Mode 2 is inhibited; and
 - c. GPWS Mode 4 uses a modified envelope (see GPWS Mode 4 description above).
2. System Sensor/Database Failures. System sensor failures, non-installation of optional sensors, database failures and combinations thereof affect the TAWS system as follows:

Sensor	Parameters Lost	Terr. Displ.	FLTA	PDA	GPWS Mode 1	GPWS Mode 2	GPWS Mode 3	GPWS Mode 4	GPWS Mode 5	500' Wake-Up
GPS (H)	AC Position	Inhibit	Inhibit	Inhibit						
TD	Terrain Elevation	Inhibit	Inhibit							
ILS	Glideslope Deviation								Inhibit	
GPS (H) + Radalt	AC Position, AGL Altitude	Inhibit	Inhibit	Inhibit	Inhibit	Inhibit	Inhibit	Inhibit	Inhibit	Inhibit
GPS (V) + ADC	MSL Altitude, VSI	Inhibit	Inhibit	Inhibit	Inhibit		Inhibit			
TD + Radalt	Terrain Elevation, AGL Altitude	Inhibit	Inhibit		Inhibit	Inhibit	Inhibit	Inhibit	Inhibit	Inhibit
GPS (V) + ADC + Radalt	MSL Altitude, VSI, AGL Altitude	Inhibit	Inhibit	Inhibit	Inhibit	Inhibit	Inhibit	Inhibit	Inhibit	Inhibit
GPS (V) + ADC + ILS	MSL Altitude, VSI, Glideslope Deviation	Inhibit	Inhibit	Inhibit	Inhibit		Inhibit		Inhibit	

Notes:

1. The combinations listed give the minimum combinations with the worst consequences. Many other combinations are possible, but their effects are subsumed within the combinations listed.
2. GPS (H) = HFOM > 0.3NM or loss of integrity or loss of navigation. Indication is "NO GPS" flag for loss of integrity or loss of navigation.
3. GPS (V) = VFOM > 75' or loss of integrity or loss of navigation. Indication is "NO GPS" flag for loss of integrity or loss of navigation.
4. GPS = GPS (H) + GPS (V). Indication is "NO GPS" flag for loss of integrity or loss of navigation.
5. TD = Terrain Data invalid. This would be due to being beyond the database boundaries, as the system will not initialize if database errors are detected on system start.
6. ADC = Air Data Computer. Indication is "NO AIR DATA" flag.
7. Radalt = Radar Altimeter. Indication is lack of radar altimeter source indication on radar altimeter display.
8. ILS = ILS Glideslope Deviation. Indication is lack of glideslope needles.

TAWS Manual Inhibit Functions:

The following manual inhibit functions can be selected by the pilot:

1. The Terrain Display function can be manually inhibited using the EFIS declutter menu.
2. All TAWS alerting functions can be manually inhibited by actuation of the external TAWS Inhibit Switch. The Terrain Display function is not affected by the TAWS Inhibit Switch.
3. In HTAWS systems, a Low Altitude Mode Switch can be actuated to inhibit or modify parameters for alerting functions. The purpose of this switch is to desensitize the HTAWS when purposefully flying VFR at low alti-

tudes. Low Altitude Mode has the following effects:

- a. If source terrain data has a resolution lower than 6 arc-seconds, the FLTA function is inhibited. If source terrain data resolution is equal to or better than 6 arc-seconds, FLTA parameters are modified.
 - b. GPWS Mode 1 is inhibited.
 - c. GPWS Mode 2 is inhibited.
 - d. GPWS Mode 3 is inhibited.
4. GPWS Mode 5 can be manually inhibited by actuation of the momentary Glideslope Cancel Switch when below 2000' AGL. GPWS Mode 5 manual inhibit is automatically reset by ascending above 2000' AGL or descending below the automatic inhibit altitude (50 feet AGL with radar altimeter AGL source or 100 feet AGL with terrain database AGL source).

Jeppesen NavData Chart Compatibility

©Copyright Jeppesen, 1994. Reprinted with permission.

Aeronautical Information Compatibility

Jeppesen Airway Manual Charts are the same publications which Jeppesen has provided to the aviation community for many years. Jeppesen NavData has not been around for quite as long, but has established and maintained the same reputation for accuracy, reliability, and dependability with those customers who use computerized navigational systems and other computer navigation data bases from Jeppesen. For those who subscribe to both services, slight differences may occasionally be noted between what is seen on the chart and what is generated from the navigation data base. These differences may be caused by any or all of the following:

1. Differences in Publication Criteria.

Jeppesen computerized NavData is updated and issued every 28 days. This is a relatively quick and simple operation for the user, since all of the changes are included on the updated media which is loaded into the aircraft navigation system or a main-frame computer system. The charts are quite a different story, as each chart must be individually updated and published. The new charts are then collated and mailed, and once received by the customer, must be filed individually in the Airway Manual. Variations, such as differences in information cut-off dates and lead time requirements, may bring about distribution in one medium before the other. These differences are generally resolved in the Jeppesen NavData NOTAMs and the Jeppesen Chart NOTAMs. The NOTAMs provide a weekly or bi-weekly update to the NavData and Chart services. A review of the Jeppesen NOTAM pages prior to using either service will help to ensure that you have the most current information.

2. Differences in the Method Used to Determine Bearing and Distance Values on Charts and in Computerized Navigational Systems.

Bearings and distances on airways, approach transitions, and instrument approaches are published in a country's Aeronautical Information Publication (AIP). Almost exclusively, these values are taken from the AIP and published on Jeppesen charts. In contrast, the navigation database contains exact locations of the navaids used to form tracks of airways, approach transitions, and instrument approaches. System software computes geodetic route bearings and distances based on the most current navaid information on the desired route, and presents this data on the system display. Slight differences in bearing and distance may not be changed in the AIP, and therefore, may not change on the Jeppesen charts. But if navaid information has changed even minutely, differences may show up because the bearings and distances displayed are computed by the navigation system or computer flight planning software each time a particular track is called up.

3. Differences in Waypoint Names and Coordinates.

Waypoint names published on Jeppesen charts are taken directly from official government sources. In some countries, there are no restrictions on the number of characters used in the name. Computerized navigation system software limits waypoint names to a maximum of five characters. Therefore, waypoint names with more than five characters will be abbreviated for entry into the navigation data base. Note that the basic structure of the name is retained, and it should be relatively easy to tie that abbreviation generated by the data base to the complete name of the waypoint on the chart. In addition, there are unnamed turning points and intersections depicted on charts which must be included in the navigation data base. Therefore, certain names may appear in a computerized system which do not appear on a chart. The method used to identify these turning points and intersections is also included in "NavData Name Conventions".

For Jeppesen Charts Dated 14 OCT 94 and Later

On standard Enroute and Area charts, for unnamed, or named

with name other than five characters and no State assigned identifier, fixes/reporting points/mileage breaks

- and -

For entry points on STAR charts and exit points on SID charts:

The NavData identifier is published, adjacent to the point involved, within square brackets, and in italic type.

Example: *[ABC73]*. Should changes occur to a charted NavData identifier prior to the re issue of the chart, the change will be announced in a special section of the Jeppesen Chart NOTAMs titled “NavData Identifiers”.

NavData identifiers are Jeppesen derived only, and should not be used for ATC flight plan filing or used in ATC communications. Coordinates on Jeppesen charts may also differ slightly from those generated by a computer. As stated in paragraph 1 above, the navigation data base is updated completely every 28 days. The charts, on the other hand, may accumulate small changes over a longer period of time. Because of these differences in publication schedules, there may be very slight differences between the charts and the NavData generated information.

4. Incompatibility of Some Routes and Instrument Approaches with Computerized Navigation System Software.

By nature of their design, some routes and instrument approach procedures are not usable by certain computerized navigation systems. For example, consider an approach transition from the enroute structure to an instrument approach. In most cases these are named and defined as STARs, or they are tied into particular instrument approach procedures. To be compatible with computerized navigation system software, one of the above prerequisites must be present, that is, the transitions must be either named STARs, or connected to instrument approach procedures. But occasionally a procedure will define an approach transition which is not a named STAR and which is not connected to an instrument approach procedure. When neither of the conditions is met, approach transitions of this type may not

be entered into the navigation data base. Certain approaches are also incompatible with system software, and may not be entered into the navigation data base. In most cases, these restrictions do not apply to publication of Jeppesen charts. All types of routes and approaches may be published on Jeppesen charts, but depending on the capabilities of the computerized navigation system, they may not appear in the system data base, and therefore you may not be able to call them up on your system display.

SUMMARY

Any or all of the above may cause slight differences between charts and information generated from the navigation data base. The Jeppesen NavData NOTAMs and Chart NOTAMs should be reviewed prior to using either Jeppesen service. As a final note, be sure to obtain a preflight briefing to ensure that you have knowledge of any last minute changes affecting your flight.

Navdata Name Conventions: Waypoint Identifiers

Waypoint names entered into the navigation data base are limited to a maximum of five characters. Official waypoint names assigned by a country's aviation information authority often have other than five characters. For compatibility with the navigation data base, waypoint identifiers are assigned to all waypoints in accordance with the ground rules set forth as follows:

A. VOR, VORDME, VORTAC, TACAN and Non-Directional Beacons (NDB).

Waypoints located at any of the above types of facilities will take on the official 1-, 2-, 3-, or 4-character identifier of the facility in question.

Examples:

Los Angeles VORTAC LAX

Tyndall TACAN PAM

Ft. Nelson NDB YE
Newark NDB EWR

B. NDB

NDB as Waypoint Concept

For systems employing the “NDB as Waypoint” concept, waypoints located at NDB’s will be identified by the use of the station identifier followed by the alpha characters “NB”.

Examples:

Ft. Nelson NDB YENB
Newark NDB EWRNB

C. Named RNAV Waypoints, Intersections and Reporting Points.

In many countries, these waypoints are assigned unique 5-character names, with the identifier the same as the name. For waypoints not so named, identifiers are developed using the following rules sequentially until 5 or fewer character groups emerge.

1. One-Word Names

- a. Use the full name if five characters or less are involved.

Examples:

ACRA, LOGAN, PIKE, DOT

- b. Eliminate double letters.

Examples:

KIMMEL becomes KIMEL
COTTON becomes COTON
RABBITT becomes RABIT

- c. Keep first letter, first vowel and last letter. Drop other vowels starting from right to left.

Examples:

ADOLPH becomes ADLPH

BAILEY becomes BAILY
BURWELL becomes BURWL

- d. Drop consonants, starting from right to left.

Examples:

ANDREWS becomes ANDRS
BRIDGEPORT becomes BRIDT

2. Multiple Word Names

Use the first letter of the first word and abbreviate the last word using the above rules for one-word names to reduce it to four characters.

Examples:

CLEAR LAKE becomes CLAKE
ROUGH AND READY becomes RREDY

3. Phonetic Letter Names.

- a. When an ICAO phonetic alpha character is used as a waypoint name (Alpha, Bravo, Charlie, etc.), use the rules established in paragraph C.1 above. When more than one waypoint in a country has the same phonetic name, obtain uniqueness by applying rule E below.

Examples:

Waypoint November becomes NOVMR
Waypoint Charlie becomes CHARE
Waypoint Alpha remains ALPHA

- b. When a double phonetic, such as Tango India, is used as the waypoint name, use the rules established in paragraph C.2 above.
- c. When a phonetic alpha character followed by a numeric and/or other alpha characters (A1, A1N, B2, etc.), is used as the waypoint name, it will appear the same in the data base as shown on aeronautical charts.

D. Unnamed Waypoints

1. Unnamed Turn Points, Intersections and Bearing/ Distance Waypoints

(For bearing/distance waypoints on terminal area procedures, see paragraph F.2)

- a. If an unnamed turn point, intersection or bearing/distance waypoint is collocated with a named waypoint or NAVAID station on a different route structure (e.g., low level or approach), the name or identifier of the collocated waypoint is used.

Example:

Unnamed turn point on J2 between Lake Charles (LCH) and New Orleans (MSY) VORTAC's is coincidental with the Lafayette (LFT) low level VORTAC. LFT is used as the identifier code for the turn point.

- b. Identifier codes for unnamed turn points, intersections or bearing/distance way-points that are not coincidental with named waypoints should be constructed by taking the identifier code of the reference NAVAID for the turn point/ intersection/ (bearing/distance waypoint) (expected to be the nearest NAVAID serving the airway structure in which it is located) and the distance from this NAVAID to the turn point/intersection/(bearing/ distance waypoint). If the distance is 99 nautical miles or less, the NAVAID identifier is placed first, followed by the distance. If the distance is 100 nautical miles or more, the last two digits only are used and placed ahead of the NAVAID identifier.

Examples:

NAVAID	DISTANCE	CODE
INW	18	INW18
CSN	106	06CSN

2. FIR, UIR and Controlled Airspace Reporting Positions

In cases where the government authority does not provide unique 5-letter or less waypoint names, and in cases where the government supplied name cannot be converted to a unique 5-letter identifier using rules C.1,

C.2, and C.3, the following rules are applied in developing an identifier for such waypoints.

- a. FIR - use the three characters “FIR” plus a numeric from 02 to 99. An identifier so developed is unique within the geographical area code.

Example: FIR09

- b. UIR - use the three characters “UIR” plus a numeric from 02 to 99. An identifier so developed is unique within the geographical area code.

Example: UIR39

- c. FIR/UIR - Use “FIR” and a numeric as indicated above.

Example: FIR69

- d. Controlled Airspace - use the 3-letter characters for the type of controlled airspace plus a numeric from 02 to 99. These are Terminal Waypoints and as such are unique within the Terminal Area. Examples of controlled airspace types are:

TMA Terminal Control Area

CTA Control Area

CTR Control Zone

TIZ Traffic Information Zone

ATZ Aerodrome Traffic Zone

Examples:

CTR03

TIZ15

3. Reporting Positions Defined by Coordinates

Entry/Exit positions to Oceanic Control Areas are often defined by waypoints which are “undesigned,” made available in source documentation as geographical coordinates (Latitude/ Longitude) expressed in full degrees. In cases where such positions are to be entered into the data base, the following rules are applied:

- a. Positions in the northern hemisphere use the letters “N” and “E”, the southern hemisphere use the letters “S” and “W” and numerics for latitude and longitude as follows:
- (1) Latitude, use values provided by source. Latitude will always precede longitude.
 - (2) Longitude, use only the last two values of the three digit longitude value. Placement of the letter designator in the five character set indicates what the first digit is published as. The letter designator will be the last character if the longitude is less than 100 degrees and will be the third character if the longitude is 100 degrees or greater.
 - (3) The letter “N” is used for north latitude and west longitude. The letter “E” is used for north latitude and east longitude. The letter “S” is used for south latitude and east longitude. The letter “W” is used for south latitude and west longitude.
- b. Examples:
- N latitude/W longitude
- N52 00/W075 00 = 5275N
- N50 00/W040 00 = 5040N
- N07 00/W008 00 = 0708N
- N75 00/W170 00 = 75N70
- N07 00/W120 00 = 07N20
-
- N latitude/E longitude
- N50 00/E020 00 = 5020E
- N75 00/E050 00 = 7550E
- N06 00/E008 00 = 0608E
- N75 00/E150 00 = 75E50
- N06 00/E110 00 = 06E10
-
- S latitude/W longitude
- S52 00/W075 00 = 5275W
- S50 00/W040 00 = 5040W
- S07 00/W008 00 = 0708W

S75 00/W170 00 = 75W70

S07 00/W120 00 = 07W20

S latitude/E longitude

S50 00/E020 00 = 5020S

S75 00/E050 00 = 7550S

S06 00/E008 00 = 0608S

S75 00/E150 00 = 75S50

S06 00/E110 00 = 06S10

E. Duplicate Identifiers

- 1. Should application of these rules result in more than one waypoint having the same identifier, a new identifier is generated for each waypoint by developing a four (or less) character identifier and adding a suffix number or letter.**

Examples:

SHAWNEE (COLO) SHAE1

SHAWNEE (CAL) SHAE2

- 2. If the suffix number reaches 10, start over with one and place the suffix in the fourth- character position.**
The original fourth character is placed in the fifth-character position.

Example: SHAWNEE (OKLA) SHA1E

F. Terminal Waypoints.

The following rules are applied in developing identifiers for waypoints used solely in terminal area procedures. Such waypoint identifiers will be unique only for the airport specified. A way-point identifier used in a terminal area cannot be repeated in that terminal area but can be used in an enroute area encompassed by the same geographical area code. Terminal way-point identifiers can be repeated in areas covered by different geographical codes. These identifier developing rules are only applied when the waypoints in question have not been assigned official names/identifiers by the government authority.

- 1. Airport-Related Waypoints** (Single Approach Procedure for given runway coded) Single Approach Procedure for given runway coded and Waypoints common to more than one approach: The following two-character codes are to be added to the runway identifier to create an airport-related waypoint identifier when no named waypoint has been established by the government source for the fix type:

FF = Final Approach Fix
AF = Initial Approach Fix
IF = Intermediate Approach Fix
CF = Final Approach Course Fix
MA = Missed Approach Point Fix
SD = Step-Down Fix

Note: if multiple step-down fix waypoints need to be created, replace “D” with another character, retain the “S”.

RC = Runway Centerline Fix
RW = Runway Fix
*OM = Outer Marker Fix
*MM = Middle Marker Fix
*IM = Inner Marker Fix
*BM = Backcourse Marker Fix
TD = Touchdown point inboard of runway threshold

*See also rule G

Examples:

FF36
MA09L

- 2. Airport-Related Waypoints** (Multiple Approach Procedure for given runway coded.)

Multiple approach Procedures for a given runway coded for which common waypoints cannot be established: The following two-character codes are to be added to the runway identifier to create an airport-related waypoint identifier when no named waypoint has been established by the government source for the fix type:

Fx = Final Approach Fix, where “x” equals the Type of procedure in question

Ax = Initial Approach Fix, where “x” equals the Type of procedure in question

Ix = Intermediate Approach Fix, where “x” equals the Type of procedure in question

Cx = Final Approach Course Fix, where “x” equals the Type of procedure in question

Mx = Missed Approach Point Fix, where “x” equals the Type of procedure in question

Sx = Step-Down Fix Note: if multiple step-down fix waypoints need to be created, replace “D” with another character, retain the “S”.

Rx = Runway Centerline Fix, where “x” equals the Type of procedure in question

Tx = Touchdown Fix inboard of runway threshold, where “x” equals the Type of procedure in question

These procedure type characters do not appear on the Jeppesen Approach Charts.

3. Bearing/Distance Waypoints

Identifiers are developed by the application of the following rules:

- a. The first character is “D”.
- b. Characters 2 through 4 signify the VHF NAVAID radial on which the waypoint lies.
- c. The last character is the DME arc radius defining the position of the waypoint on the radial. This radius is expressed as the equivalent letter of the alphabet, i.e., A = 1NM, G = 7NM, P = 16NM, etc.

Examples:

D185J

D250P

- d. If distance is greater than 26NM, use the convention in paragraph D or E.
- e. If the arc radius is provided in official government source as nautical miles and tenths of nautical miles, the letter of the alphabet will reflect values rounded to full nautical miles, i.e., 10.5nm = 11nm or K, 10.4nm = 10nm or J. All values between 0.1 and 1.4 will be character “A”.

G. Approach Marker Identification Priority Convention

- 1. If the approach marker is named, use its name.

Example: PIKKE OM Runway 26 will be PIKKE

- 2. If it is unnamed but an NDB, use the NDB ident followed by the letters NB.

Example: Ft. Nelson LOM will be YENB

- 3. If it is unnamed and not an NDB, use letters OM followed by the runway number.

Example:

Outer Marker for Runway 26 becomes OM26

BOTTOM LINE:

ALWAYS VERIFY NAVDATA APPROACH DETAILS WITH PRINTED INSTRUMENT APPROACH PROCEDURES, FLY THE SKYWAY, AND NEVER DESCEND BELOW THE MINIMUM DESCENT ALTITUDE OR DECISION HEIGHT UNLESS THE RUNWAY IS IN SIGHT.

REPORT ANY MAJOR NAVDATA INCONSISTENCIES TO CHELTON FLIGHT SYSTEMS IMMEDIATELY USING THE SERVICE DIFFICULTY REPORT IN THIS APPENDIX.

Data Logging and Retrieval

Overview

Chelton Flight Systems EFIS log all data associated with a flight, including all flight instrument and navigation data. These data can be downloaded for review after a flight.

Data from the last 5 flights are logged at a one-second interval. There is no reasonable limit to the lengths of the flights. On system initialization, each log file is a comma delimited ASCII file. The file contains a date stamp and each line contains a time stamp (Zulu time).

To access the data, power the system OFF, insert a data card, and power the system ON. Use the control knob to scroll to “Download Log Files” and push to enter.

```
Chelton Flight Systems Ground and Maintenance Functions:

Run Demonstrator/Training Program
Update Databases, Limits and Application
Download Log Files
Fuel Tank Calibration (CPU#0 or CPU#1 Only)
View Fuel Tank Calibration Map (CPU#0 or CPU#1 Only)
View bitlog.dat
L3 WX-500 Maintenance Utility (CPU#0 or CPU#1 Only)
Ryan TCAD Maintenance Utility (CPU#0 or CPU#1 Only)
Terrain Data Verification
Display Internal Temperature
Download Routes and User Waypoints
Upload Routes and User Waypoints
View System Limits (CPU#0 or CPU#1 Only)
```

The files will be copied to the data card. Power the system OFF before removing the card.

These log files (*.dat) can be opened and manipulated (charting, graphing, etc.) in Microsoft Excel or other spreadsheet applications that support comma-delimited data format or using Chelton’s FlightMetrics flight analysis software.

Data Format

There are two lines per time stamp; the first line contains navigation and airdata parameters and the second line contains engine parameters. The parameters, listed in spreadsheet column order, are as follows:

Navigation/Airdata line:

1. Time Stamp
2. Aircraft Latitude in Degrees
3. Aircraft Longitude in Degrees
4. Aircraft Altitude in Feet
5. Aircraft Pitch in Degrees
6. Aircraft Bank in Degrees
7. Aircraft Heading in Degrees True
8. Aircraft Track in Degrees True
9. Aircraft Indicated Airspeed in Knots
10. Aircraft True Airspeed in Knots
11. Aircraft Groundspeed in Knots
12. Aircraft VSI in Feet per Minute
13. Aircraft Glide path in Degrees
14. Aircraft Computed AOA in Degrees
15. Aircraft G-force
16. Computed Wind Speed in Knots
17. Computed Wind Direction in Degrees True
18. Outside Air Temperature in Degrees Fahrenheit
19. Density Altitude in Feet

Photocopy, complete, then fax to 208-389-9961.

Name:	Phone:
Flight No.	Date:
Aircraft:	N#:
Software Version:	Error Code:
Route:	Duration of flight:
Conditions:	
Remarks: (Include time, altimeter setting, OAT, ALT, IAS, TAS, GS, heading, track, position, flight segment, pilot action, system response, is problem repeatable.)	

Warranty

Chelton Flight Systems Inc. warrants to purchaser this instrument and the system components incorporated herein (the "FlightLogic Products") to be free from defects in materials and workmanship for the shorter of eighteen months from the user invoice date or twelve months from: (i) completion of installation; and (ii) a copy of the FAA 337 and associated warranty cards. Chelton Flight Systems Inc. will, at its option, repair or replace any item under the terms of this Limited Warranty provided the item is returned to the factory prepaid and insured.

1. This Limited Warranty shall not apply to any FlightLogic Product that has been repaired or altered by any person other than Chelton Flight Systems Inc. or that has been subjected to misuse, accident, incorrect wiring, negligence, or improper installation by any person. This Limited Warranty does not cover any reimbursement for any person's time for installation, removal, assembly, or repair. Chelton Flight Systems Inc. retains the right to determine, in its sole judgment, the reason or cause for warranty repair.
2. This Limited Warranty does not extend to any machine, vehicle, boat, aircraft or any other device to which the FlightLogic Products may be connected, attached, interconnected, or used in conjunction with in any way.
3. The obligation assumed by Chelton Flight Systems Inc. under this Limited Warranty is limited to repair or replacement of the FlightLogic Products, at the sole discretion of Chelton Flight Systems Inc.
4. An Authorized FlightLogic Dealer ("Dealer") shall install all FlightLogic Products sold by Dealer except those products that are specifically excluded from the installation equipment in

writing by Chelton Flight Systems Inc. Dealer may, however, sell FlightLogic Products to other authorized FlightLogic dealers on a resale basis without installation, in which case the purchasing Dealer shall install all such FlightLogic Products.

5. Dealer shall conform to all preparation and installation instructions from Chelton Flight Systems Inc. that pertain to FlightLogic Products. Dealer, purchaser or customer shall complete and mail to Chelton Flight Systems Inc. the customer warranty registration form and a copy of the completed FAA 337 within 15 days following installation. Dealer shall familiarize customer with the warranty section of the owners manual and shall use its best efforts to assist a customer in obtaining prompt warranty satisfaction pursuant to the terms of this Chelton Flight Systems Inc. Limited Warranty.

6. Chelton Flight Systems Inc. is not responsible for shipping charges or damages incurred in connection with the remedies provided under this Limited Warranty.

7. No representative of Dealer or any other person is authorized to assume any liability on behalf of Chelton Flight Systems Inc. in connection with the sale, use, installation or performance of FlightLogic Products or any other Chelton Flight Systems Inc. products.

8. Installation times may be affected by, among other factors, the installer's experience, the type of aircraft and engine type. Chelton Flight Systems Inc., at the request of a customer, Dealer or installer, may elect to modify any instrument, component(s), or feature(s) for a specific situation which may also affect installation time. In no event shall Chelton Flight Systems Inc. be responsible for the costs of, or resulting from, installation, troubleshooting, research or development, or any

other costs incurred by the customer, Dealer, installer, repair person, mechanic, technician, etc. with respect to such modification or any special installation requirements.

9. Chelton Flight Systems Inc. Limited Warranty/ Exchange Policy:

- a. Out of Box Failure ("OBF") warranty is for a period of 25 flight hours.
- b. Any failure of a Chelton Flight Systems Inc. product within the OBF will be exchanged, subject to availability, for a new unit from stock, when reasonably possible at the discretion of Chelton Flight Systems Inc.
- c. For any OBF of a Chelton Flight Systems Inc. product, the customer will have the option to: (i) have their units repaired and returned (with all shipping and handling charges to and from Chelton Flight Systems Inc. to be borne by the customer); or (ii) receive an exchange unit.
- d. An exchange unit will have a Limited Warranty period of the greater of 180 days or the unexpired portion of the original equipment warranty.

10. If you do not agree to and accept the terms of this Limited Warranty, you may return the product in resalable condition, in the sole discretion of Chelton Flight Systems Inc., with receipt, and original packaging within thirty (30) days from shipment by Chelton Flight Systems Inc. for a refund.

11. This Limited Warranty is made only to the original user of the FlightLogic Products.

12. THIS LIMITED WARRANTY IS IN LIEU OF ALL OTHER WARRANTIES OR OBLIGATIONS EXPRESS OR IMPLIED. CHELTON FLIGHTS SYSTEMS INC. EXPRESSLY DISCLAIMS ALL IMPLIED WARRANTIES OF MERCHANTABILITY OR FITNESS FOR A PARTICULAR PURPOSE. PURCHASER AGREE THAT IN NO

EVENT SHALL CHELTON FLIGHTS SYSTEMS INC. BE LIABLE TO ANY PARTY FOR SPECIAL, INCIDENTAL, OR CONSEQUENTIAL DAMAGES, INCLUDING LOST PROFITS OR LOSS OF USE OR OTHER ECONOMIC LOSS ARISING OUT OF OR RELATING TO THE INSTALLATION, USE OR PERFORMANCE OF THE FLIGHTLOGIC PRODUCTS. EXCEPT AS EXPRESSLY PROVIDED HEREIN, CHELTON FLIGHT SYSTEMS INC. DISCLAIMS ALL LIABILITY TO PURCHASER, DEALER, CUSTOMERS OR ANY OTHER PERSON IN CONNECTION WITH THE INSTALLATION, USE OR PERFORMANCE OF CHELTON FLIGHTS SYSTEMS INC.'S PRODUCTS, INCLUDING WITHOUT LIMITATION, LIABILITY IN TORT.

NOTES

[illegible]

[illegible]

NOTES

[illegible]

NOTES

[illegible]